

TD427
.P4
O4
1992

OIL SPILL

case histories

1967 - 1991

SUMMARIES of SIGNIFICANT
U.S. and INTERNATIONAL SPILLS

US Department of Commerce
NOAA Coastal Services Center Library
2234 South Hobson Avenue
Charleston, SC 29405-2413

November 1992

Report No. HMRAD 92-11 to the U.S. Coast Guard Research and Development Center

~~Property of CSC Library~~

NOAA / Hazardous Materials Response and Assessment Division

Seattle, Washington

US Department of Commerce
NOAA Coastal Services Center Library
2234 South Hobson Avenue
Charleston, SC 29405-2413

DD427.24 03 1992

FEB 22 1997

US DEPARTMENT OF COMMERCE
NOVA OCEANOGRAPHY
3110 UNIVERSITY AVENUE
CHARLOTTE, N.C. 28206

NOVA OCEANOGRAPHY

US DEPARTMENT OF COMMERCE
NOVA OCEANOGRAPHY
3110 UNIVERSITY AVENUE
CHARLOTTE, N.C. 28206-3413

Introduction

The National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR Part 300), referred to subsequently as "The National Contingency Plan" (NCP), is the principal Federal mechanism for operations pertaining to the identification, containment, and cleanup of releases of oil and hazardous substances in the coastal United States. NOAA has the responsibility, under the NCP, to provide scientific support to the U.S. Coast Guard (USCG) in planning for and responding to spill emergencies in the marine environment.

Discussions between the USCG Research and Development Center and NOAA concluded that, by providing insights into past experiences, a database of oil spill case histories might be beneficial to the USCG, NOAA, and other agencies involved in spill response and contingency planning. These case histories, developed with significant funding and consultation from the USCG Research and Development Center, are intended as references to be read as planning aids for insights into scientific and operational decision-making, and to ensure that particular strategic elements are properly addressed in contingency planning. Although the files are configured for ready accessibility to details of particular spills, these case histories can be used for constructing hypothetical scenarios and for "gaming" a spill, e.g., "given the actual response to spill x, what would you do?" or "what would you have done differently, and why?"

Criteria were established to limit the initial number of spills to be evaluated. The case histories include all spills that:

- exceeded 100,000 barrels internationally
- exceeded 10,000 barrels in U.S. waters
- involved the use of dispersants
- involved bioremediation
- involved severe environmental impacts: more than 500 birds killed, more than 100 mammals killed, smothering of over a mile of intertidal zone, closure of fisheries, etc.

Following this introduction there is an alphabetical list of spill case histories included in the report and a dictionary of key words. The key words comprise the dictionary from which shoreline types, resources at risk, etc. are chosen. The dictionary was developed by Research Planning Inc., Columbia, South Carolina (*Guidelines for Developing a Spill Preparedness Plan: Focus on Environmental Information*, 1992, NOAA report HMRAD 92-3.)

Each case history is organized as follows:

- A list of *headers* that summarizes the spill name, location, product, size, use of dispersants, bioremediation, and in-situ burning, other special interests, shoreline types affected and keywords. (For the computerized version, any word can also be searched as if it were a designated keyword.)
- A brief *incident summary* including weather conditions and events leading up to the spill.
- A description of the *behavior* of the oil including movement, evaporation, mousse formation, and dispersion.
- A discussion of *countermeasures* and *mitigation*.
- A description of *other special interest* issues such as communication problems, unusual hazards encountered, and large losses of organisms.
- A list of *references* from which the history was synthesized. The list ranges from very skimpy to very extensive; early spills were not well documented.

Items within the text that the reader may want to find rapidly are highlighted by the use of ***boldface italics***. These include proper names, amounts, or unusual conditions.

Sources of information for the case histories include U.S. Coast Guard OSC Reports and Pollution Reports, file reports of the International Tanker Owners Pollution Federation Ltd., NOAA Scientific Support Coordination (SSC) Branch spill reports, commercial newsletters in the public domain, state agency reports, industry reports, and published scientific reports. Oil properties were taken from Environment Canada's *Catalogue of Crude Oil and Oil Product Properties (1990 version)* (unpublished report EE-125, Ottawa). References are included at the end of each case history.

The complete database consists of two parts: a text file, available on diskette or as hard copy, and a HyperCard stack on diskette summarizing each of the case histories. The HyperCard stack is based on CAMEO™, hazardous materials planning and response software developed by NOAA and the U.S. Environmental Protection Agency.

We intend to add future spills to the database that meet the criteria for notable impacts or innovative responses even though the size of the spill falls below the values selected initially. Past spills will be re-reviewed with the same intention. As new data are discovered, or participants in past spills provide additional information, case histories will be updated. SSC reports are now being prepared in the format used in this report. We encourage other national and international

This is one of several computer-based projects being conducted by the U.S. Coast Guard and NOAA to improve planning and response to oil spills. We would particularly like to thank Cdr. Peter Tebeau of the USCG Research and Development Center for his support of these projects.

Contributors to this report included:

| | |
|------------------------------------|--------------------------|
| Cheryl Anderson ¹ | |
| Robert Barry ² | |
| Kenneth Barton ³ | |
| R.G.B. Brown ⁴ | |
| Gini Curl ³ | Cover Art |
| Herbert Curl, Jr. ³ | Project Manager |
| Sharon Christopherson ³ | |
| Dean Dale ² | Project Coordinator |
| Christopher Hall ² | |
| Lori Harris ³ | Editor |
| John Kaperick ³ | |
| David Kennedy ³ | |
| Edwin Levine ³ | |
| Dan Mattson ² | |
| Barry McFarland ² | |
| Jacqueline McGee ² | |
| Clark Lee Merriam ⁵ | |
| Jim Morris ³ | |
| John Murphy ² | |
| Robert Pavia ³ | |
| Ellen Shaw ² | |
| Jean Snider ³ | NOAA-Coast Guard Liaison |
| Lynette Stevens ² | |
| Melody Straub ² | |
| Ian C. White ⁶ | |

¹Minerals Management Service, U.S. Department of the Interior

²Genwest Systems Inc.

³Hazardous Materials Response and Assessment Division, National Oceanic and Atmospheric Administration

⁴Canadian Wildlife Service

⁵The Cousteau Society

⁶International Tanker Owners Pollution Federation, Ltd.

Oil Spill Case Histories

| SPILL NAME | LOCATION | DATE | BARRELS |
|------------------------------------|--|----------|-------------|
| <i>Al Rawdatain</i> | Genoa, Italy | 10/29/77 | 7,350 |
| <i>Alvenus</i> | Cameron, LA | 7/30/84 | 65,000 |
| <i>Amazon Venture</i> | Savannah River, GA | 12/4/86 | 11,900 |
| Amerada Hess Oil Co. storage tanks | Port Alucroix, Limetree Bay, St. Croix, U.S.V.I. | 9/20/89 | 10,000 |
| <i>American Trader</i> | Huntington Beach, CA | 2/7/90 | 9,458 |
| <i>Amoco Cadiz</i> | Brittany, France | 3/16/78 | 1,619,048 |
| APEX 3417, 3503 Barges | Galveston Bay, TX | 7/28/90 | 16,476 |
| Arabian Gulf/Kuwait | Persian Gulf | 1/19/91 | 900,000,000 |
| <i>Aragon</i> | Madeira, Portugal | 12/29/89 | 175,000 |
| ARCO Anchorage | Port Angeles, WA | 12/21/85 | 5,690 |
| <i>Argo Merchant</i> | Nantucket, MA | 12/15/76 | 183,000 |
| <i>Arrow</i> | Nova Scotia, Canada | 2/4/70 | 77,000 |
| Ashland Petroleum Co. | Monongahela River | 1/2/88 | 23,810 |
| <i>Assimi</i> | Oman | 1/7/83 | 379,000 |
| <i>Athenian Venture</i> | Canada | 4/22/88 | 252,429 |
| <i>Bahia Paraíso</i> | Palmer Station, Antarctica | 1/28/91 | 3,774 |
| <i>Bayou Lafousche</i> | Upper Galveston Bay, Houston Ship Channel, TX | 3/9/73 | 10,000 |
| <i>Betelgeuse</i> | Bantry Bay, SW Ireland | 1/8/79 | 14,720 |
| <i>Borag</i> | Keelung, Taiwan | 2/5/77 | 213,692 |
| <i>Bouchard #65</i> | Buzzards Bay, MA | 1/9/77 | 1,932 |
| <i>Brazilian Marina</i> | Sao Sebastiao, Brazil | 1/9/78 | 73,600 |
| Buckeye Pipeline | Knapp Run, PA | 3/30/90 | 1,786 |
| <i>Burmah Agate</i> | Galveston Bay, TX | 11/1/79 | 254,761 |
| <i>Cabo Pilar</i> | Punta Davis, Chile | 10/8/87 | 40,900 |
| <i>Chevron Hawaii</i> | Deer Park, TX | 9/1/79 | 20,000 |
| Chevron Main Pass Block 41 | 11 miles E of Mississippi River delta | 2/10/70 | 65,000 |
| <i>Christos Bitas</i> | Irish Sea, South Wales | 10/12/78 | 21,990 |
| <i>Concho</i> | Kill Van Kull, NY | 1/19/81 | 18,149 |
| <i>Corinthos</i> | Delaware River, Marcus Hook, PA | 1/31/75 | 266,000 |
| E-24 | Block Island Sound, Fishers Island, NY | 11/22/85 | 71 |
| Ekofisk Bravo oil field | Norway, North Sea | 4/22/77 | 202,381 |
| <i>Eleni V</i> | Norfolk, SE Coast of England | 5/6/78 | 52,500 |
| ESSO Puerto Rico | Mississippi River, LA | 9/3/88 | 23,000 |
| <i>Ethel H (III)</i> | Hudson River, NY | 2/4/77 | 10,000 |
| Exxon Bayway Refinery | Arthur Kill, NY | 1/2/90 | 13,500 |
| <i>Exxon Valdez</i> | Prince William Sound, AK | 3/24/89 | 240,500 |
| Funiwa No. 5 | Niger Delta, Forcados, Nigeria | 1/17/80 | 200,000 |
| <i>General Colocotronis</i> | Eleuthera, Bahamas | 3/7/68 | 37,700 |
| <i>Globtik Sun</i> | Gulf of Mexico | 8/15/75 | 7,000 |
| <i>Grand Eagle</i> | Delaware River, Marcus Hook, PA | 9/28/85 | 10,357 |
| Hackensack Estuary, Tank Farm | Hackensack, NJ | 5/26/76 | 47,619 |
| <i>Hamilton Trader</i> | Liverpool Bay, England | 4/30/69 | 4,000 |
| Hasbah 6 | Saudi Arabia, Gulf of Arabia | 10/2/80 | 100,000 |
| <i>Haven</i> | Genoa, Italy | 4/11/91 | 142,857 |
| <i>Howard Star</i> | Tampa Bay, FL | 10/5/78 | 952 |
| <i>Independenta</i> | Istanbul, Turkey | 11/15/79 | 687,785 |
| <i>Irene's Challenge</i> | Pacific Ocean | 1/17/77 | 237,600 |
| Ixtoc I | Bahia de Campeche, Gulf of Mexico | 6/3/79 | 352,400 |
| <i>Jakob Maersk</i> | Leixoes, Portugal | 1/29/75 | 637,500 |
| <i>Jupiter</i> | Saginaw River, Bay City, MI | 9/16/90 | 20,000 |
| <i>Khark 5</i> | Morocco, (N of Las Palmas, Canary Islands) | 12/19/89 | 452,400 |
| <i>Kirki</i> | Cervantes, Western Australia | 7/21/91 | 135,000 |
| <i>Kurdistan</i> | Cabot Strait, Newfoundland | 3/15/79 | 43,900 |
| Lakehead Pipeline Company | Grand Rapids, MN | 3/3/91 | 40,476 |
| MCN-5 | Guemes Channel, Shannon Point, WA | 1/31/88 | 1,604 |

Oil Spill Case Histories

| SPILL NAME | LOCATION | DATE | BARRELS |
|---|---|----------|-----------|
| <i>Mega Borg</i> | Gulf of Mexico | 6/8/90 | 100,000 |
| <i>Metula</i> | First Narrows, Strait of Magellan | 8/9/74 | 398,019 |
| <i>Mobiloil</i> | Columbia River, OR | 3/19/84 | 3,925 |
| <i>Nestucca</i> | Grays Harbor, WA | 12/23/88 | 5,500 |
| <i>Nord Pacific</i> | Corpus Christi, TX | 7/13/88 | 15,350 |
| <i>Nowruz Oil Field</i> | Persian Gulf, Iran | 2/4/83 | 1,904,762 |
| <i>Ocean Eagle</i> | San Juan, Puerto Rico | 3/3/68 | 83,400 |
| <i>Olympic Alliance</i> | Dover Strait, Pas de Calais, English Channel | 11/12/75 | 14,000 |
| <i>Olympic Glory</i> | Houston Ship Channel, TX | 1/28/81 | 20,000 |
| <i>Oregon Standard</i> | San Francisco, CA | 1/18/71 | 20,400 |
| <i>Pac Baroness</i> | Point Conception, CA | 9/21/87 | 9,200 |
| <i>Pacific Glory</i> | English Channel, Isle of Wight | 10/23/70 | 24,780 |
| <i>Patmos</i> | Strait of Messina, Italy | 3/21/85 | 5,300 |
| <i>Peck Slip</i> | Cape San Juan, Puerto Rico | 12/19/78 | 11,000 |
| <i>Presidente Rivera</i> | Delaware River, Marcus Hook, PA | 6/24/89 | 7,310 |
| <i>Puerto Rican</i> | San Francisco Bay, CA | 10/31/84 | 38,500 |
| <i>Rockaway Fuel Oil Spill</i> | Rockaway Point, NY | 7/31/78 | 1,000 |
| <i>Ryuyo Maru #2</i> | St. Paul Island, AK | 11/8/79 | 6,190 |
| <i>Sanko Harvest</i> | Esperance, Western Australia | 2/13/91 | 4,400 |
| <i>Sansinena</i> | Los Angeles Harbor, CA | 12/17/76 | 30,000 |
| <i>Santa Barbara Well Blowout</i> | Santa Barbara, CA | 1/28/69 | 100,000 |
| <i>Schuylkill River Spill</i> | Douglassville, PA | 6/22/72 | 170,000 |
| <i>Sea Speed Arabia</i> | New York Upper Harbor, NY | 6/30/79 | 2,857 |
| <i>Sea Spirit</i> | Strait of Gibraltar, Mediterranean Sea | 8/6/90 | 48,875 |
| <i>Sea Star</i> | Gulf of Oman | 12/19/72 | 937,000 |
| <i>Seal Beach Well Blowout</i> | Seal Beach, CA | 10/31/90 | 20 |
| <i>SFI 41</i> | Mile 43.7 Upper Mississippi River, MO | 11/24/85 | 16,300 |
| <i>Shell Oil Complex</i> | Carquinez Straits, Martinez, CA | 4/23/88 | 8,700 |
| <i>Shell Platform 26</i> | Gulf of Mexico, Louisiana | 12/1/70 | 58,640 |
| <i>Sitand</i> | Humber Estuary, England | 9/28/83 | 48,000 |
| <i>St. Peter</i> | Cabo Manglares, Colombia | 2/5/76 | 279,000 |
| <i>STC-101</i> | Chesapeake Bay, Northampton County, VA | 2/2/76 | 5,959 |
| <i>Tamano</i> | Casco Bay, ME | 7/22/72 | 2,380 |
| <i>Tanio</i> | Brittany, France | 3/7/80 | 98,955 |
| <i>Tarik Ibn Ziyad</i> | Rio de Janeiro, Brazil | 3/26/75 | 109,950 |
| <i>Tenyo Maru</i> | Neah Bay, WA | 7/22/91 | 7,143 |
| <i>Texaco Storage Tank</i> | Bahia Las Minas, Panama | 4/27/86 | 240,000 |
| <i>Texas</i> | Mile 43.4, Upper Mississippi River, MO | 3/7/86 | 17,055 |
| <i>Torrey Canyon</i> | Lands End, England | 3/18/67 | 860,000 |
| <i>Trinimar Marine Well 327</i> | Gulf of Paria, Venezuela | 8/8/73 | 36,650 |
| <i>U.S. Strategic Petroleum Reserve</i> | West Hackberry, LA | 9/21/78 | 72,000 |
| <i>UMTB 283</i> | Aleutian Islands, AK | 12/26/88 | 47,620 |
| <i>Urquiola</i> | La Coruna, Spain | 5/12/76 | 733,000 |
| <i>V.I. Water and Power Authority</i> | Christiansted, St. Croix, U.S.V.I. | 9/18/89 | 14,070 |
| <i>V884/V885/V883/V882</i> | Mile 179.0, Upper Mississippi River, MO | 4/2/83 | 13,212 |
| <i>Venoil</i> | Cape St. Francis, South Africa | 12/16/77 | 219,000 |
| <i>Vista Bella</i> | Nevis Island (British), eastern Caribbean | 3/6/91 | 13,300 |
| <i>Wafra</i> | Cape Agulhas, South Africa | 2/27/71 | 200,000 |
| <i>Whidbey Island spill</i> | Whidbey Island, WA | 12/21/84 | 119 |
| <i>Witwater</i> | Galeta Island, Canal Zone, Panama | 12/13/68 | 14,000 |
| <i>World Glory</i> | Durban, South Africa | 6/13/68 | 334,043 |
| <i>World Prodigy</i> | Narragansett Bay, Newport, RI | 6/23/89 | 6,873 |
| <i>YUM II/Zapoteca</i> | Bahia de Campeche, Gulf of Mexico | 10/10/87 | 58,640 |
| <i>Z-102</i> | Ensenada de Boca Vieja, San Juan, Puerto Rico | 12/9/75 | 7,679 |
| <i>Zoe Colocotronis</i> | Cabo Rojo, Puerto Rico | 3/18/73 | 37,579 |

Dictionary of Keywords

A Resources at Risk

Habitats

(See *shoreline types* key below), eelgrass beds, submerged aquatic vegetation (SAV), kelp, coral reefs, worm beds

Marine Mammals

Whales, dolphins, sea lions, seals, sea otters, manatees, walruses, polar bears, population concentration areas, haulouts, migration routes, seasonal use areas

Terrestrial Mammals

Mustelids, rodents, deer, bears, population concentration areas, intertidal feeding areas

Birds

Diving coastal birds, waterfowl, alcids, petrels, fulmars, shorebirds, wading birds, gulls, terns, raptors, rookeries, foraging areas, wintering areas, migration stopover areas, wintering concentration areas, nesting beaches, migratory routes, critical forage areas

Fish

Anadromous fish, beach spawners, kelp spawners, nursery areas, reef fish (includes fish using hard-bottom habitats) spawning streams, spawning beaches, estuarine fish, demersal fish

Molluscs

Oysters, mussels, clams, scallops, abalone, conch, whelk, squid, octopus, seed beds, leased beds, abundant beds, harvest areas, high concentration sites

Crustaceans

Shrimp, crabs, lobster, nursery areas, high concentration sites

Reptiles

Sea turtles, alligators, nesting beaches, concentration areas

Recreation

Beaches, marinas, boat ramps, diving areas, high-use recreational boating areas, high-use recreational fishing areas, State Parks

Management Areas

Marine Sanctuaries, National Parks, Refuges, Wildlife Preserves, Reserves

Resource Extraction

Subsistence, officially designated harvest sites, commercial fisheries, power plant water intakes, drinking water intakes, industrial water intakes, intertidal and subtidal mining leases, fish/shrimp/bivalve/plant aquaculture sites, log storage areas

Cultural

Archaeological sites, Native American Lands

B Shoreline Types Impacted

brackish marshes
coarse gravel beaches
coarse sand beaches
coastal structures
consolidated seawalls
consolidated shores
cypress swamps
developed upland
eroding bluffs
exposed bedrock bluffs
exposed bluffs
exposed fine sand beaches
exposed riprap
exposed rocky platforms
exposed rocky shores
exposed scarps
exposed seawalls
exposed tidal flats
exposed tidal flats (low biomass)
exposed tidal flats (moderate biomass)
exposed unconsolidated sediment bluffs
extensive intertidal marshes
extensive salt marshes
extensive wetlands
fine sand beaches
flats
freshwater flat
freshwater marshes
freshwater swamps
fringing salt marshes
fringing wetlands
hardwood swamps
levees
low banks
mangroves
marshes
mixed sand and shell beaches
mixed sediment beaches
piers
riprap
salt marsh
saltwater marshes
sand/gravel beaches
shell beaches
sheltered bedrock bluffs
sheltered fine-grained sand beaches
sheltered impermeable banks
sheltered mangroves
sheltered marshes
sheltered rocky shores
sheltered seawalls
sheltered tidal flats

B, cont.

shelving bedrock shores
spoil bank
supratidal marshes
swamp
tidal mudflat
unforested upland
unvegetated steep banks and cliffs
vegetated bluffs
vegetated low banks
vegetated riverbank
vertical rocky shores
wavecut platforms

C

Key words

absorbent pads
absorbents
adverse weather conditions
air activated pumps
air horns
Air-Deliverable Anti-Pollution Transfer System (ADAPTS)
airboats
Airspace Request Zone
Alpha Bio-Sea microbes
Ardox 6120
Atlantic Strike Team (AST)
Audubon Society
backhoes
Bennett boom
blowout
blowout preventer
boat ramps
bombing
boom
BP 1002
BP 1100D
BP 1100WD
BP 1100X
BRAS-X-plus
bulldozers
California Department of Fish and Game (CA DFG)
cannonball diaper sampler
Centers for Disease Control (CDC)
chalk
Channel Islands National Marine Sanctuary
clamshell bucket
Clean Bay Inc.
Clean Coastal Waters
Clean Gulf
Clean Harbors Cooperative
Clean Seas
Clean Sound
Clean Water

C, cont.

- collection boom
- collision
- containment boom
- contingency plan
- contracting
- copper
- copper sulfide
- Corexit 7664
- Corexit 8666
- Corexit 9527
- Corexit 9580
- Crowley Environmental Services
- Customblen
- Dasic LTD
- Davidson Current
- deflection booms
- Delaware Bay and River Cooperative
- demolition
- detergent
- disposal
- Drew
- drift cards
- elastol
- Enjay 7664
- evaporation
- Expandiboom
- explosion
- filter fence
- Finasol OSR
- Finasol OSR-2
- Finasol OSR-5
- Finasol OSR-7
- fingerprinting
- fire
- Flight Restricted Area
- fog
- Food and Drug Administration (FDA)
- Gold Crew
- Goodyear boom
- Gulf Strike Team (GST)
- hand mops
- high-pressure hot water washing
- high-pressure warm-water washing
- high-pressure washing
- high-viscosity screw pumps
- hot-water flushing
- hydro-blasting
- Infra Red (IR)
- Inipol
- International Bird Rescue and Research Center (IBRRC)
- International Tanker Owners Pollution Federation (ITOPF)
- Intervention on the High Seas Act

C, cont.

JBF skimmer
lightering
low pressure washing
Magnus
manual removal
Marco skimmer
Multi Agency Local Response Team (MALRT)
National Guard
National Strike Force (NSF)
National Wildlife Refuges
Navy boom
New Jersey State Department of Environmental Protection (NJ DEP)
New York State Department of Environmental Conservation (NY DEC)
oil mop machines
oil snares
Open Water Oil Containment and Recovery System (OWOCS)
Open Water Oil Recovery System (OWORS)
Pacific Strike Team (PST)
Point Reyes National Seashore
Polycomplex A
pompoms
propane cannons
Regional Response Team
relief well
remote response
remotely operated vehicle (ROV)
recoiling
salvage
sawdust
Sea Curtain boom
self-contained skimming devices
self-propelled skimmer
shallow water recovery
Shell Oil Herder
Shell Solvent 70
Shell VTS
shop vacuums
Side Looking Airborne Radar (SLAR)
sinking
siphon dam
skimmers
skimming pump
Slickgone LTE
Sorbent C
sorbent boom
sorbent pads
sorbent pillows
sorbent pompoms
sorbents
steam generators
stern trawl net
straw

C, cont.

- sub-surface oil
- submersible
- suction operations
- supersucker
- toxic fumes
- trenches
- Tri-State Bird Rescue Center
- Tullanox 500
- U. S. Naval Explosive Ordnance Detachment (EOD)
- U.S. Navy Superintendent of Salvage (NAVSUPSALV)
- US Strategic Petroleum Reserve
- vacalls
- vacuum pumps
- vacuum truck
- vegetation cutting
- volunteers
- Washington Department of Ecology (WA DOE)
- Washington Department of Natural Resources (WA DNR)
- water-washing
- weir sump
- weir/pump skimmer

D Other Special Interest Issues

- Effects to tourism, recreation areas, or personal property
- Closure of commercial or recreational fishing areas and public lands
- Closure of shipping lanes and vehicle traffic routes

- Wildlife impacts and rehabilitation
- Ecological destruction and habitat loss due to spilled material impacts
- Ecological destruction and habitat loss due to cleanup operations
- Effects to human health and safety

- Bioremediation, dispersant, in-situ burning operations
- Unusual, experimental, or innovative cleanup techniques
- Complex successful salvage operations
- Logistical or operational problems (including adverse weather conditions)
- Interaction with foreign or Native authorities
- Media interest
- Volunteer response and organization
- Studies conducted; ongoing research

Name of Spill: *Al Rawdatain*
Date of Spill (mmddyy): 10/29/77
Location of Spill: Genoa, Italy
Latitude: 44 24 N
Longitude: 008 48 E
Oil Product: Kuwait crude oil
Oil Type: Type 3
Barrels: 7,350
Source of Spill: Tank Vessel
Resources at Risk: commercial fisheries, recreational beaches, sardines, anchovies, prawns.
Dispersants: Yes
Bioremediation: No
In-situ Burning: No
Other Special Interest:
Shoreline Types Impacted:
Keywords: Gamlen LT126, Finasol OSR2, Chimisol TC 66, Saros Meltout M, Urruty Dispersol, Rochem, skimmer.

Incident Summary:

On October 29, 1977, a valve was left open during the offloading of the *Al Rawdatain* at the Genoa-Multedo dock. Seven thousand three hundred fifty barrels of Kuwait crude oil spilled from the vessel over a period of several hours. The spill was mitigated with chemical dispersants. No shoreline impacts occurred.

Behavior of Oil:

Kuwait crude oil is a medium weight product with an API gravity of 31.2 and a viscosity of 2.53 centistokes. Overflights on the morning of October 30 revealed a slick extending out 275 yards from the vessel. By October 31, a 7 mile long by 3 mile wide slick extended out to sea. A smaller amount of oil broke off from the large slick and moved west towards Savona. This oil formed a 5 mile long by 3 mile wide slick which stayed 2 miles off the shore between Cogoleto and Varazza. No oil contaminated the shoreline.

Countermeasures and Mitigation:

The Genoa Port Authority was responsible for cleanup operations. On October 31, dispersants were applied to the offshore slick and in the vicinity of the tanker's mooring by 4 tugboats, which were directed by observers in helicopters. Two tugs were fitted with *Warren Springs Laboratory dispersant spraying equipment* and storage tanks. The other two tugs used improvised spraying gear. A harbor launch applied dispersants to the smaller slick near Savona on the morning of October 31. Two fire monitoring tugs joined the Savona operations later that day, and sprayed dispersants into the night using search lights. Overflights revealed that no significant amounts of oil persisted after the dispersants were applied. Operations were considered successful and were completed by November 2 in perfect weather.

A *Gaima skimmer* was deployed near Genoa, but it broke down almost immediately.

Approximately 1190 barrels (50,000 gallons) of dispersants were used, and included: Gamlen LT126, Finasol OSR2, Chimisol TC 66, Saros Meltout M, Urruty Dispersol, and Rochem.

Other Special Interest Issues:

References:

- Genwest Systems, Inc. communications with ITOPF representatives.

Name of Spill: *Alvenus*
Date of Spill (mmddyy): 07/30/84
Location of Spill: Calcasieu River bar channel, 11 miles SE of Cameron, Louisiana.
Latitude: 29 35 N
Longitude: 093 15 W
Oil Product: Venezuelan Merey, Pilon Crude
Oil Type: Type 3, Type 3
Barrels: 65,000
Source of Spill: Tank Vessel
Resources at Risk: Benthic organisms, marsh grass, bird nesting sites, sea turtles.
Dispersants: Y
Bioremediation: N
In-situ Burning: N
Other Special Interest: Logistical or operational problems, effects to tourism.
Shoreline Types Impacted: Exposed seawalls, piers, fine sand beaches, sheltered tidal flats.
Keywords: Corexit 9527, hydro-blasting, reoiling, International Tanker Owners Pollution Federation (ITOPF), sub-surface oil, manual removal.

Incident Summary:

On July 30, 1984 at 1236 the U.K. Tank Vessel *Alvenus* *grounded* in the Calcasieu River Bar Channel 11 miles southeast of Cameron, Louisiana. The vessel suffered a structural failure which ruptured the hull near the No.2 tanks. The resulting spill of approximately *65,500 barrels of Venezuelan Merey and Pilon crude oil* was carried in a westerly direction by wind and currents. Offshore recovery was hampered by rough weather and the magnitude of the spill. The water temperature was 80°F and winds were from the east and northeast 15-20 knots.

The spill moved slowly westward, coming ashore near High Island, along the Bolivar Peninsula, and into Galveston Bay, Texas between Aug. 2-5. Oil impacts were severe at Rollover Inlet and Crystal Beach, and on Aug. 4 more oil was pushed ashore further south along the Galveston Island coast. The spill affected 90% of Galveston's West Beach, including 80% of the Galveston seawall and the associated rock groins and pilings. Oil in the seawall area was a concern due to the oils smothering effect on marine organisms. Organisms in this area were determined to be a minor part of the entire ecosystem and due to their transient nature were able to move to more suitable habitats. Several dead crabs, rays, and fish were recovered along the seawall but could not be directly attributed to the spill. Also oiled were marsh grass areas in East Bay (10-20 barrels) and 2 small lagoons. Some oil which entered Galveston Channel did affect several small sand islands used as nesting sites for birds, although no affected birds or eggs were reported. One oiled sea turtle was cleaned and released. *Tourism losses were estimated at \$1 million per day.* Commercial shrimp fishermen filed a suit for \$10 million. By October 1 the oiled beaches of Bolivar Peninsula and Galveston Island had been cleaned by the removal of oiled sand.

Behavior of Oil:

Merrey crude oil is a medium crude oil with an API gravity of 17.3 and a pour point of -10 degrees F. Pilon crude is a heavy crude oil of API gravity 13.8 with a pour point of -9 degrees F and a viscosity of 1,943 centistokes. The spill formed a heavy, coalescent slick which was initially predicted to move offshore to the south away from the Texas coast. Changes in wind direction resulted in a westerly trajectory, spreading the oil into a 75 mile long slick with three leading arms. The oil came ashore in the Galveston, Texas area forming as tar balls, sheens, and pancakes floating outside the surf zone. By August 7 an estimated 17,000 - 26,000 bbl (2,500-3,500 tons) of oil had accumulated on the shores of Galveston Island and the Bolivar Peninsula. *An additional 7400 - 11,100 bbl (1,000-1,500 tons) of oil adsorbed onto suspended solid particles (sediment) nearshore and sank in the surf zone where it was trapped among successive sandbars and trenches forming "blankets" to 4 inches in depth.* Some of the subtidal oil formed cylindrical shaped rolls that moved up and down the beach with wave action. Warm temperatures on the beach (80°F water, 80-100°F air) may have contributed to keeping the oil highly fluid and fresh. Unless mixed with sand, the oil was easily dispersed with gentle agitation.

Countermeasures and Mitigation:

Oil booms and sea barrier were placed around the vessel on the day following the grounding. Efforts to contain and recover the spilled oil at sea became ineffective due to rough seas which pushed oil under the barrier, and *the refusal of the contracted lightering barge to receive oil recovered from seawater. This refusal was a major contribution to the failed recovery effort.* A second barge and tug were contracted, but delayed due to a line becoming fouled in the screw of the towing vessel. The principal contractor, Clean Gulf Association, an industry cooperative, was not equipped for massive at-sea cleanup and equipment was not immediately available in Cameron, Louisiana. Had the equipment been available, *it still may not have been loaned to a non-member company.*

Beach cleanup was determined to be best accomplished by using *road graders to move newly beached oil above the high tide zone.* Graders were most effective when used together in a staggered formation, moving oil up the beach from the intertidal area to backshore storage areas. Oiled sand collected in the storage areas was loaded into dump trucks for disposal. This operation involved as many as 50 graders and 100 dump trucks. *Submerged oil in the subtidal* proved to be the greatest problem because reoiling necessitated continual recleaning of beaches. Removal of the subtidal oil was attempted with mesh screening, pumping, and heavy equipment, but none of these techniques proved effective. During beach cleanup, *conflict arose between state and private landowners* over ownership of the contaminated sand, the state wanting to remove the sand versus the landowners wanting it to remain in place on the beach.

Cleaning of the seawall and revetment involved more than 150 workers manually removing oil with sorbent materials, shovels, and rakes. *Various "hydo-blasting" methods were tried.* Low-pressure (850 psi) warmed seawater left stains on the rocks, a high-pressure "sugar" sand blast was effective on the rocks but not concrete seawall, and dry sand blasting proved too abrasive. *Hydro-sand blasting* was chosen as the most effective for seawall cleanup. *A test of dispersant (Corexit 9527) was approved and conducted* on the seawall. When the *dispersant was unable to penetrate the oil*, hydroblasting remained the method of choice.

Extensive discussions with experts and representatives of the International Tanker Owners Pollution Federation concerning dispersants concluded that dispersant use on the water was not appropriate due to water depth, proximity of the spill to shore and fisheries resources, and the inability of the dispersant to penetrate thick Venezuelan crude. Since the dispersant would have been only partially effective, the cost benefit of using an ineffective dispersant would have diverted funds from the beach cleanup deemed necessary in either case. See discussion below about subsequent dispersant use on the seawall.

Other Special Interest Issues:

Logistics became a problem during the beach cleanup due to the large number of heavy equipment units involved. Traffic constraints at disposal sites resulted in as many as 40 loaded vehicles waiting on the beaches to off-load. Graders were only available from the Texas Department of Highways for a short time, so cleanup began prematurely, requiring recleaning as new oil came ashore.

Mass balance calculations estimated the volume of the recovered oil at between 63,000 - 78,000 bbl (8,700 - 10,700 metric tons). This is very high considering that an estimate of the total spill was 65,000 bbl (10,000 metric tons).

A severe case of oiling at a previously unaffected San Luis Pass area was cleaned up by the contractor and later analysis proved the oil was not of *Alvenus* origin.

Ten liters of Exxon Corexit 9527 were applied to *Alvenus* oil stranded on the Galveston seawall on August 28, 1984. Ten samples were taken from the sea water at the base of the seawall before and after the application of Corexit 9527 and analyzed for polynuclear aromatic hydrocarbons (PAHs) by The Center for Bio-Organic Studies, University of New Orleans. The analytical data were interpreted by the Institute for Environmental Studies, Louisiana State University. Concentrations of aromatic hydrocarbons were very low and no discernable effects of the dispersant were obvious in the data set. Observations of marine organism mortalities made by National Marine Fisheries Service indicated no toxic effects.

References:

- Alejandro, A.C. and J.L. Buri, 1987. M/V Alvenus: Anatomy of a major oil spill. Oil Spill Conference Proceedings 1987, pp. 27-32.
- Baxter, Todd, NOAA SSC. Memo to Participants of the ALVENUS Oil Spill, January 4, 1984.
- NOAA Hotline report
- Petro-Canada report ("Alvenus file")
- USCG On Scene Coordinators report
- World Information Systems "Tanker losses in U.S. Waters 1978-1990"

Name of Spill: *Amazon Venture*
Date of Spill (mmddyy): 12/04/86
Location of Spill: Savannah River, Garden City, Georgia
Latitude: 40 35 N
Longitude: 073 52 W
Oil Product: No. 6 Fuel Oil
Oil Type: Type 4
Barrels: 11,900
Source of Spill: Tank Vessel
Resources at Risk: Oysters, clams, crabs, refuges, high-use recreational fishing areas, commercial fisheries, birds.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Habitat impact due to oil.
Shoreline Types Impacted: Marshes, piers, riprap, sheltered seawalls, marshes, saltwater marshes.
Keywords: Gulf Strike Team (GST), containment boom, National Wildlife Refuges, vacuum truck, manual removal, sorbent boom, high-pressure washing.

Incident Summary:

On December 4, 1986, at 2330, an oil spill of unknown origin at the Garden City, Georgia container berths on the Savannah River was reported to the U.S. Coast Guard (USCG) Marine Safety Office (MSO) in Savannah, Georgia. As the responsible party had not been identified, the On-Scene Coordinator (OSC) declared a federally funded spill to facilitate response measures.

Early in the morning on December 5, before the source of the spill was known, personnel contracted by the USCG deployed containment boom at the Amoco and Southern Bulk Industries facilities. At first light, the *Amazon Venture* was boarded and inspected as it was believed to be the most likely source of the spill. The cause of the spill was later determined to be three malfunctioning valves in the ballast and cargo discharge piping of the *Amazon Venture*.

Behavior of Oil:

No. 6 fuel oil is a heavy product with an API gravity that ranges from 7 to 14. The amount of spilled oil was initially estimated to be less than 50 barrels. During the first two days of the spill, much of the floating oil remained beneath the approximately eighteen acres of dock and wharf area at the edge of the Savannah River. On December 7, personnel from the *USCG Gulf Strike Team (GST)* estimated that the amount of oil in the water was about 11,000 barrels. The final estimate was reached on December 11, following tank gauging that revealed that approximately twelve thousand barrels of the *Amazon Venture's* cargo was missing.

Approximately 25 miles of the Savannah River and its tributaries were affected by the spill. An estimated 610 acres of marsh were oiled along the canals and tributaries of the *Savannah National Wildlife Refuge (SNVR)*. Thirty-eight acres along major waterways were heavily oiled, and eighty acres along major waterways were lightly oiled.

Countermeasures and Mitigation:

Shoreline cleanup consisted of *washing with pressurized water and hand scrubbing* of oiled surfaces. Dispersant use was not considered due to the environmental sensitivity of the area. The National Oceanic and Atmospheric Administration (NOAA) Scientific Support Coordinator (SSC) recommended against cutting marsh grass. Since the spill occurred in winter, the grass was dormant at the time and it was felt that little harm would come to the grass if it were left intact. Also, increased traffic associated with grass cutting could force oil deeper into the sediments.

Areas with the heaviest concentrations of oil were isolated with *containment boom*. The oil was too thick initially for *vacuum trucks* to have any effect. A barrier boom was deployed at Middle River to protect the waters of the Savannah National Wildlife Refuge. The swift currents of the river made securing the boom very difficult, however, it was in place by the morning of December 6. Five hundred feet of boom was deployed at Steamboat Cut in the SNVR on December 9. Sorbent boom was deployed at Fort Jackson and Fort Pulaski. Sorbent boom was deployed across the Dundee Canal at the request of the Georgia Department of Natural Resources (DNR) to prevent oil from contaminating sensitive inland areas.

Containment boom was deployed at seven sites in the wildlife refuge as recommended by the U.S. Fish and Wildlife Service (FWS). Oil in the contained areas was difficult to remove because of currents and the relatively small amount of oil actually contained by the booms. Booms were placed at Hog Island, St. Augustine Creek, Upper Little Back River, Rifle Cut, and Middle River. Booms in these areas required constant maintenance and repositioning due to the currents. All booms were removed from the wildlife refuge by December 23.

Limited cleanup operations continued until January 12, 1987. On January 16, the OSC presented the vessel owners with the final recommendations for the long-term cleanup and removal of the oil. The cleanup was completed by March 13, 1987.

Other Special Interest Issues:

Disposal of oily debris was a problem. *The dumpsters provided by the cleanup contractor were unlined.* This caused oil to leak into the soil around the dumpsters until a dike was constructed and the dumpsters were lined with plastic, pending the acquisition of proper containers.

The FWS established a bird cleaning center. The center cleaned only a few birds because the spill had only a minimal effect on the birds in the area. Approximately *36-48 oiled birds* were sighted by FWS personnel. Most of these were *cormorants*. There were fears that the Bald Eagles in the Refuge would prey on the oiled birds, however no reports of affected Bald Eagles were received.

References:

- Golob's 1978-1989 US Spill Report
- MMS Worldwide Tanker Spill Database
- NOAA Hotline Reports
- NOAA Response Report
- OSIR Oil Spills, International Summary & Review, 1986-1988
- Tanker Advisory Center, Inc. 1991 Guide for the Selection of Tankers. T.A.C. Inc. 1991.
- USCG On-Scene Coordinators Report
- World Information Systems. Tanker Losses in U.S. Waters: 1978-1990. World Information Systems. 1991.

Name of Spill: Amerada Hess Oil Co. storage tanks
Date of Spill (mmddyy): 09/20/89
Location of Spill: Port Alucroix, Limetree Bay, St Croix, U.S. Virgin Islands.
Latitude: 17 40 N
Longitude: 064 45 W
Oil Product: Heavy crude oil
Oil Type: Type 4
Barrels: 10,000
Source of Spill: Facility
Resources at Risk: piers.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Human health and safety concerns, adverse weather conditions, logistical or operational problems.
Shoreline Types Impacted: Fine sand beaches, exposed rocky shore.
Keywords: Atlantic Strike Team (AST), adverse weather conditions, boom, skimming pump, oil snares, clamshell bucket.

Incident Summary:

On September 18, 1989, *Hurricane Hugo* hit the island of St. Croix with winds in excess of 140 miles per hour. **Five large oil storage tanks** were destroyed and several severely damaged at the Hess Oil Virgin Islands Corporation (HOVIC) power plant in Port Alucroix, St Croix. Of the 10,000 barrels released, approximately 9,000 barrels were contained within earthen berms on the facility's grounds.

Coast Guard personnel of the Marine Safety Office (MSO) San Juan participated in an overflight of the area on September 21. The overflight was conducted to assess damages to two affected facilities. Members of the *USCG Atlantic Strike Team* and the Federal On-Scene Coordinator arrived on-scene September 22 to inspect the damaged storage tanks. Approximately 1,000 barrels of heavy crude oil were in HOVIC's main tanker harbor. HOVIC employees had already begun countermeasures to contain the oil. HOVIC personnel appeared to need little assistance from the Coast Guard. Coast Guard personnel continued on to Virgin Islands Water Power Authority (VI WAPA) to assess the damages and needs at that facility.

Behavior of Oil:

Approximately 1,000 barrels of heavy crude escaped into the waters of Limetree Bay. Natural wind and wave action pressed the oil against the shoreline, thus containing the oil within the narrow tanker harbor limits. Almost all of the 1,000 barrels were recovered.

Countermeasures and Mitigation:

HOVIC employees quickly deployed 2,000 feet of *24 inch skirt boom* between the piers to contain most of the oil in the harbor. HOVIC provided VI WAPA additional booms to help contain the spill on the north side of the island.

Earthen berms on the facility grounds contained approximately 9000 barrels of the estimated 10,000 barrels that were released. *Skimming pumps* were unsuccessful in recovering the oil at HOVIC due to the high pour point of the oil. As an alternative cleanup technique, *oil-snare absorbent* was applied to the boomed oil after which it was recovered by *clamshell buckets*. The buckets were used to lift the oil into a temporary earthen sump onshore. Using this method, HOVIC was able to recover the majority of the water-borne oil and return it to an intact recovery tank. HOVIC accepted additional recovered oil from the VI WAPA spill that was placed into another recovery tank.

Other Special Interest Issues:

Due to the destruction from Hurricane Hugo, communications were disrupted. Therefore, mobile satellite communications were critical to the success of the response operation. Much of the island's infrastructure, including potable water, electricity, and sanitation facilities, was also destroyed by the hurricane. The widespread destruction on the island caused many logistical and operational problems. The resulting oil spill was simply one component of a much larger scale disaster.

Response personnel experienced physical threats from *armed groups of escaped convicts* eluding capture in remote beach areas. Some *civilians were also armed with weapons* to protect their property from crowds of looters. Personnel at the VI WAPA command post regularly heard gunfire in the evenings.

The HOVIC facility was extremely well prepared for this response. The facility itself is designed to provide excellent opportunity for containment and recovery of spills. The northwest corner of each pier contains an oil recovery ramp. HOVIC was also able to provide VI WAPA with boom, a tank barge, and an oil recovery tank.

References:

- Bills, C.E. and Whiting, D.C. 1991. Major Oil Spills Caused by Hurricane Hugo, St. Croix, U.S. Virgin Islands. Oil Spill Conference Proceedings 1991. pp. 247-251.
- OSIR International Spill Statistics 1989-1990, Special Report, 3/28/91
- OSIR Oil Spills, International Summary & Review, 1989-1990

Name of Spill: *American Trader*
Date of Spill (mmddyy): 02/07/90
Location of Spill: Huntington Beach, California
Latitude: 33 38 N
Longitude: 118 01 W
Oil Product: Alaskan North Slope Crude Oil
Oil Type: Type 4
Barrels: 9458
Source of Spill: Tank Vessel
Resources at Risk: Kelp, marshes, terns, diving coastal birds, shorebirds, clams, refuges, fish.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Wildlife impacts, wildlife rehabilitation, human health and safety concerns.
Shoreline Types Impacted: Exposed rocky shores, riprap, exposed bluffs, fine sand beaches, piers, sand/gravel beaches, marshes.
Keywords: Boom, Open Water Oil Containment and Recovery System (OWOCS), U.S. Navy Superintendent of Salvage (NAVSUPSALV), sorbent pompoms, sorbent boom, sorbent pads, California Department of Fish and Game (CA DFG), International Bird Rescue and Research Center (IBRRC), Air-Deliverable Anti-Pollution Transfer System (ADAPTS), Expandiboom, vacuum truck, Marco skimmer, hot-water flushing, Clean Coastal Waters, Clean Seas, Pacific Strike Team (PST), National Wildlife Refuges, manual removal.

Incident Summary:

On February 7, 1990 at 1620, the single-hull tank vessel *American Trader* grounded on one of its anchors while approaching the Golden West Refining Company's offshore mooring. Two holes were punctured in one of the vessel's cargo tanks, releasing 9458 barrels of heavy crude oil into the water approximately 1.3 miles from Huntington Beach, California.

The master of the vessel immediately reported the incident to the USCG Marine Safety Office/Group Los Angeles-Long Beach (MSO/Group LA-LB). The master moved the *American Trader* into deeper water one mile to the south. The commanding officer of the MSO/Group assumed the role of the Federal On-Scene Coordinator (FOSC). The responsible parties assumed full financial responsibility for the spill and sent representatives to the Long Beach area.

Oil began to come ashore on February 8 in light concentrations around Newport Pier. By February 9, oil was ashore at Huntington Beach; in some instances, oil in the surf zone here appeared to be in heavier concentrations than observed earlier at Newport Beach.

Calm seas and fair weather for most of the response period resulted in a rapid and successful cleanup. All of the beaches were cleaned by March 2. The FOSC concluded all cleanup operations by April 3.

The 22,000 barrels of crude remaining in the damaged cargo tank were lightered by personnel from the USCG Pacific Strike Team and the responsible party using the USCG Air-Deliverable Anti-Pollution Transfer System (ADAPTS). By 1200 on February 9, the oil from the damaged tank plus 90,000 barrels from the mid-body tanks had been transferred into barges to decrease the draft of the vessel. Temporary patches were applied to the holes in the hull and the *American Trader* was moved to an oil transfer facility in Long Beach Harbor to off-load the remaining 470,000 barrels of crude oil. The vessel was moved to San Francisco on February 18 for drydocking and repair.

Behavior of Oil:

Alaska North Slope Crude Oil is a medium weight oil with an API gravity of 26.5 and a pour point of 0 degrees F. The release of oil from the damaged hull was rapid. Both of the puncture holes were in the No. 1 starboard wing tank. None of the other cargo tanks were damaged. The released oil was driven by the prevailing winds to the NNW of the grounding site. By the morning of the second day, the wind direction had changed and was blowing the oil away from the coastline. Most of the oil was held offshore by winds in a forty square-mile slick for the first five days of the response, which allowed cleanup crews to concentrate on an extensive open-water recovery operation.

On February 13, 35 knot winds forced most of the remaining slick ashore along fourteen miles of shoreline from Long Beach Harbor to Newport Beach. Heavy oil sludge and emulsified oil accumulated up to two inches thick in places. Most of this area had received only light to moderate oiling in the previous five day period.

Countermeasures and Mitigation:

Booming of the sensitive wetlands of the Bolsa Chica National Wildlife Refuge, Newport Bay, and the mouth of the Santa Ana River was completed by 0200 on February 8. Double harbor booms were deployed at Anaheim Bay, Newport Bay, and across the mouth of the Santa Ana River. Small skimmers were stationed behind the first barrier to recover oil which passed beyond it. *Sorbent boom* was also deployed between the two hard booms to collect oil which passed the outer barrier. Sorbent boom was placed across the mouths of shallow inland channels in the Bolsa Chica marshlands.

Personnel from Orange County Flood Control constructed *earthen berms* across the three channels of the Santa Ana River to keep oil from entering the sensitive wetlands. The currents and tidal action in the river had made exclusionary booming ineffective. *Heavy rain runoff washed away all three berms* on February 17 and deposited debris from upriver onto Huntington Beach. The berms were repaired before any oil contaminated the wetlands. The berms proved to be very effective until February 25 when five to ten gallons of oil were washed over the berm into the Huntington Beach wetlands by high tides and surf. This oil was removed with sorbent pads with minimal damage to the wetlands.

As a result of prompt exclusion booming, no contamination to the wetlands at Bolsa Chica and Newport Bay was observed. However, the FOSC recommended that future exclusion booming operations *employ a sturdier boom, such as Expandiboom*, to prevent this outermost barrier from parting during heavy weather.

Open-water recovery was done with fifteen skimming vessels and twenty-five support/boom tow vessels. The USCG Pacific Strike Team responded to the scene with two Open Water Oil Containment and Recovery System skimming barriers (OWOCRS). The U.S. Navy Supervisor of Salvage (NAVSUPSALV) provided seven *Marco Class V* skimmers. The Clean Coastal Waters and Clean Seas oil spill cooperatives provided three large offshore skimmers. This extensive open-water recovery effort resulted in the recovery of 14,000 barrels of emulsified oil and water (estimated to be over 25 per cent of the spilled oil). Offshore skimming operations were concluded by February 17, as most of the remaining oil had beached by that time.

Beach cleanup methods included of manually deployed sorbent booms, sorbent pads, and manual removal. These techniques were used to prevent destruction of the beach face and accelerated shoreline erosion that would have been caused by moving heavy equipment on the beaches. *Sorbent pompoms* were strung together and pulled through the surf zone to collect oil before it contacted the beaches.

The exposed rocky shorelines, exposed bluffs, and riprap in the area of the Bolsa Chica Bluffs, Newport Finger Piers, and Santa Ana River jetties were heavily oiled by emulsified oil mousse and oil sludge during the February 13

storm. Sorbents and *vacuum trucks* were used to remove free-standing pools of oil. These areas were further cleaned using *hot-water flushing* and spraying. The *temperature of the water was controlled* by personnel from the *California Department of Fish and Game* (CA DFG) to keep it within the tolerance of the organisms inhabiting the rocks.

Most of the beaches were cleaned and opened to the public by March 2. Cleaning of the rocky shorelines and riprap took place during February and March. All of the shoreline cleaning was completed by April 3. In the final days of the spill, concern was expressed over the human health threat posed by reopening beaches that had been contaminated by oil. MEDTOX, a British Petroleum contractor, conducted limited surveys to determine the level of contamination. Survey results indicated no risk to human health. Additionally, a modified EPA sand sampling test determined safe hydrocarbon limits for each beach before it was reopened. The approval process for reopening cleaned beaches was carried out by representatives of the USCG, CA DFG, and the city responsible for the beach.

On the evening of February 7, the use of dispersing chemicals applied to dissipate the spilled oil was discussed. The State of California concluded that the waters in the vicinity of the vessel were too shallow to consider dispersant use and a conclusive threat to specific wetland areas could not be identified, as required by California state law.

Other Special Interest Issues:

Out of the 1,017 oiled birds taken to the bird rescue centers, *502 birds died* as a result of the oiling. Two Pacific white-sided dolphins died from ingesting oil. A *bird rehabilitation center* was set up on Terminal Island and a *bird rescue center* was set up on Huntington Beach. Both centers were staffed by paid contractors and volunteers, and were managed by biologists from CA DFG, British Petroleum, and the *International Bird Rescue and Research Center (IBRRC)*. Birds were initially cleaned at the Huntington Beach center and then transported to the Terminal Island center for further cleaning and rehabilitation. Rehabilitated birds were released approximately sixty miles north of the spill location near Point Mugu.

The major coastal bird species at risk was the brown pelican, a diving bird that could become completely coated by oil while diving through the surface of the water to feed. The Snowy Plover, a shorebird in the area, could also ingest contaminated organisms at oiled shorelines. Many shorebird species, however, tend to seek out non-contaminated areas for feeding. *One hundred forty one Brown Pelicans, an endangered species, were oiled during the spill; sixty-eight of these died, an estimated 1.5 percent of the population at the time.*

Over one hundred grunion died while attempting to spawn on the oiled beaches near the Bolsa Chica Bluffs according to wardens from the CA DFG.

References:

- Card, CPT J.C., and Meehan, LT J.A. 1991. Response to the American Trader Oil Spill. Oil Spill Conference Proceedings 1991. pp. 305-311.
- NOAA Response Report
- Rolan, R.G. and Cameron, K.H. 1991. Adaptation of the Incident Command System to Oil Spill Response During the American Trader Spill. Oil Spill Conference Proceedings 1991. pp. 267-272.
- USCG On-Scene Coordinators Report
- White, J. and Williams, T. 1991. Saving Endangered Species in Major Oil Spill Cleanup Efforts, Oil Spill Conference Proceedings 1991, pp. 221-223.

Name of Spill: *Amoco Cadiz*
Date of Spill (mmddyy): 03/16/78
Location of Spill: Brittany, France
Latitude: 48 35 N
Longitude: 004 43 W
Oil Product: Arabian light crude, Iranian light crude, Bunker C.
Oil Type: Type 2, Type 2, Type 4
Barrels: 1,619,048
Source of Spill: Tank Vessel
Resources at Risk: Oysters, clams, crustaceans, kelp, diving coastal birds, waterfowl, bird nesting beaches, commercial fisheries.
Dispersants: Yes
Bioremediation: Yes
In-situ Burning: No
Other Special Interest: Unusual or experimental cleanup techniques, habitat impacts due to oil, habitat impacts due to cleanup operations, adverse weather conditions, wildlife impacts, research conducted, closure of public lands, closure of commercial fishing areas, closure of recreational fishing areas, effects to tourism, effects to personal property, effects to recreation areas, media interest.
Shoreline Types Impacted: Marshes, sand/gravel beaches, exposed rocky shores, piers, developed upland, salt marsh, tidal mudflat.
Keywords: Adverse weather conditions, boom, skimmer, vacuum truck, manual removal, high-pressure hot water washing, sub-surface oil, remote response, BP 1100X, Finasol OSR, BP 1100WD, Finasol OSR-5, chalk, low pressure washing, disposal.

Incident Summary:

On March 16, 1978, the *Amoco Cadiz* ran aground on Portsall Rocks, three miles off the coast of Brittany due to failure of the steering mechanism. The vessel had been en route from the Arabian Gulf to Le Havre, France when it encountered stormy weather which contributed to the grounding. The entire cargo of 1,619,048 barrels, spilled into the sea. *A slick 18 miles wide and 80 miles long polluted approximately 200 miles of Brittany's coastline.* Beaches of 76 different Breton communities were oiled.

The isolated location of the grounding and rough seas restricted cleanup efforts for the two weeks following the incident. Severe weather resulted in the complete break up of the ship before any oil could be pumped out of the wreck. As mandated in the "Polmar Plan," the French Navy was responsible for all offshore operations while the Civil Safety Service was responsible for shore cleanup activities. Although the total quantity of collected oil and water reached 100,000 tons, less than 20,000 tons of oil were recovered from this liquid after treatment in refining plants.

Behavior of Oil:

Both Arabian Light and Iranian Light crude oil are medium weight oils with an API gravity of 33.8. Bunker C is a heavy product with an API of between 7 and 14. A 12-mile long slick and heavy pools of oil were smeared onto 45 miles of the French shoreline by northwesterly winds. Prevailing westerly winds during the following month spread the oil approximately 100 miles east along the coast. One week after the accident, oil had reached Cotes de Nord.

Oil penetrated the sand on several beaches to a depth of 20 inches. Sub-surface oil separated into two or three layers due to the extensive sand transfer that occurred on the beaches during rough weather. Piers and slips in the small harbors from Porspoder to Brehat Island were covered with oil. Other impacted areas included the pink granite rock beaches of Tregastel and Perros-Guirec, as well as the tourist beaches at Plougasnou. The total extent of oiling one month after the spill included approximately 200 miles of coastline.

Oil persisted for only a few weeks along the exposed rocky shores that experienced moderate to high wave action. In the areas sheltered from wave action, however, the oil persisted in the form of an asphalt crust for several years.

Countermeasures and Mitigation:

A 2.5-mile long segment of *boom* protected the Bay of Morlaix. Although it required constant monitoring, the boom functioned properly because this sheltered area was protected from severe weather and from receiving excessive quantities of oil. *Boom was largely ineffective in other areas due to strong currents and enormous quantities of oil.*

Skimmers were used in harbors and other protected areas. *However, skimmer efficiency was limited due to the blocking of pumps and hoses by seaweed. Vacuum trucks* were used to remove oil from pier and boat slip areas where the seaweed was thick.

"Honey wagons," vacuum tanks designed to handle liquid manure, were effective in pumping out the emulsified oil along the coast. These wagons were able to pump oil, water, and seaweed. After the water and oil were separated as much as possible, the tanks were emptied through filter-buckets into interim storage tanks. When interim storage tanks were not available, the oil mixture was stored in large holes that were dug in the ground and lined with plastic sheets.

Stranded oily seaweed was manually removed from the beaches using rakes and front-end loaders. Natural cleaning of the sand by wave action occurred on oil penetrated beaches after ploughing and harrowing of the sediments.

Both artificial fertilizers and bacterial cultures were poured on the oily sand before harrowing.

Several brands of diluted and concentrated *dispersants*, including *BP 1100 X*, *Finasol OSR*, *BP 1100 WD*, and *Finasol OSR -5*, were used by the French Navy. Good dispersion of oil was difficult since the emulsified oil was several centimeters thick in some places.

Approximately 650 metric tons of *oleophilic chalk*, *Nautex*, was applied in an effort to sink the oil and prevent it from entering the "goulet de Brest." After one month at sea, the oil was so viscous that the chalk could not penetrate it.

A *rubber powder* made from old tires was applied to promote oil absorption. The powder was spread with water hoses aboard French Navy ships or applied manually by workers from small fishing boats. Wave action proved to be insufficient in mixing the powder with the oil. The powder had little effect on the slick because it remained on top of the oil.

High-pressure hot water (fresh water at 2,000 psi, heated to 80° - 140°C) was very effective in cleaning oil from rocky shoreline areas during the third and fourth months of cleanup. A small amount of *dispersant* was applied to prevent the oiling of the cleaned rocks during the next high tide.

Several of the impacted rivers contained oyster beds and marshes that required manual cleaning. Soft mud river banks were cleaned by using a *low pressure water* wash to push the oil down the river. To make collection more efficient, a sorbent material was mixed with water and poured in front of the washing nozzles. The oil was later collected by a locally developed device called an "*Egmolap*." This device was able to collect any material floating in sheltered areas.

Much of the collected oil was stored at Brest and Tregastel and treated with *quick-lime* for encapsulation and stabilization.

Other Special Interest Issues:

The nature of the oil and rough seas contributed to the rapid formation of a "chocolate mousse" emulsification of oil and water. This viscous emulsification greatly complicated the cleanup efforts. *French authorities decided not to use dispersants in sensitive areas or the coastal fringe where water depth was less than 50 meters.* Had dispersant been applied from the air in the vicinity of the spill source, the formation of mousse may have been prevented.

At the time, the *Amoco Cadiz* incident resulted in the largest loss of marine life ever recorded from an oil spill. Mortalities of most animals occurred over the two month period following the spill. *Two weeks following the accident, millions of dead mollusks, sea urchins, and other bottom-dwelling organisms washed ashore.* Diving birds constituted the majority of the nearly 20,000 dead birds that were recovered. The oyster mortality from the spill was

estimated at 9,000 tons. Fishes with skin ulcerations and tumors were caught by fishermen in the area. Some of the fish caught in the area reportedly had a strong taste of petroleum. Although echinoderm and small crustacean populations almost completely disappeared, the populations of many species recovered within a year. *Cleanup activities on rocky shores, such as pressure-washing, also caused habitat impacts.*

The *Amoco Cadiz* spill was one of the most studied oil spills in history. Many studies remain in progress. This was the largest recorded spill in history and was the first spill in which estuarine tidal rivers were oiled. No follow-up mitigation existed to deal with asphalt formation and problems that resulted after the initial aggressive cleanup. *Additional erosion of beaches occurred in several places where no attempt was made to restore the gravel* that was removed to lower the beach face. Many of the affected marshes, mudflats, and sandy beaches, were low-energy areas. Evidence of oiled beach sediments can still be seen in some of these sheltered areas. Layers of sub-surface oil still remain buried in many of the impacted beaches.

References:

- 8/9/91 & 8/28/91 Letters from Daniel Owen at ITOPF
- Bellier, P. and G. Massart. 1979. The Amoco Cadiz oil spill cleanup operations - An overview of the organization, control, and evaluation of the cleanup techniques employed, Oil Spill Conference Proceedings, 1979, pp.141-145.
- Bocand, et al. 1979. Cleaning products used in operations after the Amoco Cadiz disaster, Oil Spill Conference Proceedings, 1979, pp.163-167.
- D'Ozouville, et al. 1979. Occurrence of oil in offshore bottom sediments at the Amoco Cadiz oil spill site, Oil Spill Conference Proceedings, 1979, pp.187-191.
- Gundlach, E. and Marshall, M. 1990. The Physical Persistence of Spilled Oil: An Analysis of Oil Spills Previous to Exxon Valdez. Final Report. HAZMAT. OAD. NOAA. pp.21-41.
- Gundlach, et al. 1983. The Fate of AMOCO CADIZ Oil. The Physical Persistence of Spilled Oil: An Analysis of Oil Spills Previous to Exxon Valdez. Final Report. HAZMAT. OAD. NOAA. pp. A90-A97.
- Hann, R.W. 1979. Unit operations, unit processes and level of resource requirements for the cleanup of the oil spill from the supertanker Amoco Cadiz. Oil Spill Conference Proceedings, 1979, pp.147-161.
- Hayes, et al. 1979. Role of dynamic coastal processes in the impact and dispersal of the Amoco Cadiz oil spill (March, 1978) Brittany, France, Oil Spill Conference Proceedings, 1979, pp.193-198
- Hooke, N. Modern Shipping Disasters 1963-1987. Lloyds of London Press. 1987.
- MMS Worldwide Tanker Spill Database
- OSIR Newsletter 2/21/91
- OSIR Oil Spills, International Summary & Review, 1978-1981
- Overton, E. 1979. Chemical characterization of mousse and selected environmental samples from the Amoco Cadiz oil spill, Oil Spill Conference Proceedings, 1979, pp.169-173.
- Review of Oil Spill Occurrences and Impacts, Exxon Production Research Company, 1989.
- Samain. 1979. Ecophysiological effects of oil spills from Amoco Cadiz on pelagic communities - preliminary results, Oil Spill Conference Proceedings, 1979, pp.175-185.
- The SocioEconomic Impacts of Oil Spills, Final Report, WAPORA, March 1984.
- Vandermeulen, J.H. 1982. Oil Spills: What Have We Learned? Oil and Dispersants in Canadian Seas-Research Appraisal and Recommendations. Environment Canada. pp. 29-46.

Name of Spill: *Apex 3417 Barge, Apex 3503 Barge*
Date of Spill (mmddyy): 7/28/90
Location of Spill: near buoy 58 in Galveston Bay, Texas
Latitude: 29 29.9 N
Longitude: 094 52.2 W
Oil Product: No. 5 Oil (Vacuum Oil / Catalytic Feed Stock)
Oil Type: Type 4
Barrels: 16,476
Source of Spill: Tank Barge
Resources at Risk: Wading birds, waterfowl, marshes, submerged aquatic vegetation, rookeries, spawning beaches, seed beds.
Dispersants: No
Bioremediation: Yes
In-situ Burning: No
Other Special Interest: Closure of public lands, closure of shipping lanes, effects to recreation areas, research conducted, human health and safety concerns.
Shoreline Types Impacted: Exposed seawalls, piers, fine sand beaches, fringing salt marshes, extensive salt marshes, marshes.
Keywords: Low pressure washing, vacuum truck, sorbent boom, containment boom, skimmer, shallow water recovery, Alpha Bio-Sea microbes, collision, sinking, salvage, Clean Gulf, lightering.

Incident Summary:

On July 28, 1990, at 1430, the Greek Tank Vessel *Shinoussa* collided with the tank barges *Apex 3417* and *Apex 3503* in the Houston Ship Channel (HSC) near buoy 58 in Galveston Bay, Texas. All three cargo tanks of the *Apex 3417* were damaged, as well as the aft tank of the *Apex 3503*, resulting in the *release of nearly 17,000 barrels* of No. 5 oil (vacuum oil/catalytic feed stock) into Galveston Bay. A third tank barge also under tow, the *Apex 3510*, was not damaged in the collision.

The *Apex 3417* sank with its stern resting on the bottom of the channel and only its bow showing above the water. It released nearly all of its cargo, over 15,000 barrels of oil, over the course of two days. *Apex 3503* was less damaged and ultimately released 1130 barrels of oil into the water. The *Apex 3510* was towed to Houston, discharged its 23,000 barrel cargo, and returned on July 30 to offload the remaining oil from the *Apex 3503*.

The USCG Marine Safety Office (MSO) Galveston closed the Houston Ship Channel to marine traffic from two miles north to two miles south of the incident site (between buoys 51 and 60). *Apex Towing Co., Inc.* immediately accepted responsibility for the spill. *Apex* hired Riedel-Peterson Environmental Services to contain the oil at the site of the barges, and T & T Marine Salvage to raise and remove the *Apex 3417* barge from the channel.

On July 29, Malin Environmental was hired for additional cleanup assistance, and the Clean Gulf Association provided skimmers for use by Apex. In a meeting with the USCG On-Scene Coordinator (OSC), Apex was criticized for allowing the cleanup contractors to operate without direct supervision. At the suggestion of the OSC, Apex hired O'Brien Oil Pollution Services to oversee the cleanup operations as well as Garner Environmental Services and Industrial Cleanup, Inc. for additional cleanup support.

On July 30, the cargo of the *Apex 3503* was lightered to the *Apex 3510* which was then taken to Houston for offloading. On July 31, the HSC was opened to inbound single-width barge tows only, under positive control of the Vessel Traffic Service, and with assistance from at least one tug when proceeding past the accident site. These traffic restrictions remained in effect until August 3. Following the movement of *Apex 3417* from the middle of the channel on August 3, the HSC was restricted to one-way traffic only, with direction of travel being reversed every 8 to 12 hours. After cleaning, gas freeing, and welding repairs, *Apex 3417* was towed to Galveston. The HSC was opened to all ship traffic without restriction on August 10. Cleanup operations continued until the case was closed on August 17, 1990.

Behavior of Oil:

Results of the initial overflight on July 28 showed a sheen to the South of *Apex 3417* extending 0.75 miles. By late afternoon, the sheen was reported to be 3 miles long. On the first day, the oil moved to the SSW under the influence of the winds and tides. A shift in the wind on the second day resulted in the movement of the slick to the NE of the accident site, with sheen extending 3.5 miles.

Oil landed on the eastern shoreline of Red Fish Island on July 29, with a heavy accumulation along its one-mile length. By the end of the day, the slick reached from four miles north to two miles south of the accident site, consisting mostly of sheen with heavy streamers of oil to the north. On July 30, oil impacted the Texas City Dike and the north side of Pelican Island, 10 miles south of the accident site. Oil continued to move to the north, south, and west driven by tidal currents and changing winds. By the morning of August 3, oil had made landfall along the northern shoreline of Galveston Bay. The primary focus of the cleanup shifted to this area, as only lighter residual oiling existed on the southern and western shorelines.

A study performed by Louisiana State University characterized the oil as a non-sticky, heavy, refined product similar to 20W-50 motor oil. This allowed stranded oil to be re-floated by the tide rather than strongly adhering to objects and surfaces.

Countermeasures and Mitigation:

Containment boom was in place by the morning of July 29 around the leaking barges to keep the oil at the incident site. Booms were placed across the entrance to Dickinson Bayou and the cooling water intake channel for the Houston Lighting and Power Bacliff generating plant.

On July 29, the Texas Water Commission (TWC) Chairman and the Deputy Commissioner of the Texas General Land Office suggested the use of *bioremediation* for mitigation of the spill. The OSC felt that *bioremediation was not essential to the cleanup of the spill, but permitted it*, provided that payment came from the state or the spiller directly. Additionally, any bioremediation plan would need approval of the Region 6 Regional Response Team (RRT).

Four skimmers arrived on-scene on the morning of July 30 and began skimming operations on the heavy concentrations of oil within the containment boom around the barge, and to the north of the accident site. *Shallow water skimmers*, capable of operating in 2-3 feet of water, proved to be highly useful during the response to skim oil and deploy booms. Skimmers and boats that were incapable of operating in these depths suffered frequent groundings in the shallow estuaries. Skimmers, sent complete with operators and support, were put to use immediately upon their arrival; the crews and support for the Clean Gulf Association skimmers had to be contracted separately which caused additional delays. *A deck barge equipped with two vacuum trailer units* was also used at the collision site.

Cleanup operations began on July 31 on all impacted shorelines using *vacuum trucks and sorbent booms and pads*. On August 1, the wind shifted again to the SSE and remained from that direction for the next five days. The oil slick moved steadily to the North and stranded along the northern shoreline of the bay on August 3. The shallow water depth (less than six feet) in the estuaries hampered operations with boats and skimmers. Deflection booms were positioned east of Houston Point to direct oil to the shore for removal by vacuum trucks. *Low-pressure washing* was used on the shoreline at Red Fish Island, as well as some small sites near Cedar Point.

On August 2, approximately *100 pounds of Alpha Bio-Sea microbes* with a nutrient additive were applied to the marsh at the north end of Pelican Island. On August 5, an application of 140 pounds of Bio-Sea microbes was made in the Marrow Marsh area, just south of the entrance to Cedar Bayou. Another application took place on August 6 at a point farther south of Cedar Bayou using 150 pounds of Bio-Sea microbes. The final application of Bio-Sea microbes was made on August 13 at Marrow Marsh to treat residual oil remaining in an untreated site.

On August 10, surveys by members of the TWC, Texas Parks and Wildlife, and the USCG determined that shoreline cleanup was complete except for the final application of bioremediation agent to the Marrow Marsh area. The

final shoreline survey was satisfactorily completed on August 17 and the case was closed.

Other Special Interest Issues:

The proposed TWC bioremediation plan was approved by the RRT, allowing bioremediation in these areas:

- Open water with concentrated oil
- Open water surface oil contained with booms
- Impacted marshes with oil on grass, exposed mud and water surface
- Beaches with residual oil following mechanical cleanup

The TWC presented a monitoring plan which was required by the RRT. The RRT directed that the application of bioremediation take place away from the commercial oyster beds, if possible, and that it not interfere with any other cleanup activities. Water and sediment samples were collected at various times until 11 days after the bioremediation application, but determination of the effectiveness of the bioremediation was inconclusive. Results of EPA laboratory analyses of samples showed no noticable differences between treated and untreated plots 48 hours after microbe application. NOAA gas chromatography/mass spectroscopy analyses of samples before and after treatment showed no apparent changes in the relative abundances of specific compounds in the oil. Because biodegradation takes place slowly, the 11 day period of sampling may not have been long enough. Results were clouded by poor control of the application and the disturbance of test areas by human activities and livestock.

On July 31, the Division of Shellfish Sanitation Control of the Texas State Department of Health ordered a *ban on the removal of shellfish, shrimp, and finned fish* from Galveston Bay in the area of the spill site until a determination of fitness for human consumption was made. On August 2, this was altered to include all of Galveston Bay. On August 4 the ban on fin fishing was lifted, but the ban on shellfish and shrimp removal remained in effect until September 2.

On August 1, Apex announced its intention to terminate cleanup response, having reached the limit of liability. The OSC assumed federal responsibility for the cleanup on August 2, keeping all the current cleanup companies on contract. Apex continued to oversee the salvage operation until its completion.

On August 5, TWC reported a *fish kill of 200-300 speckled trout* NE of the Houston Light and Power spillway near the Trinity River outflow.

References:

- Draft OSC Report
- Golob's Oil Pollution Bulletin II.16,17,26
- Greene, CPT T.C. 1991. The Apex Barges Spill, Galveston Bay, July 1990, Oil Spill Conference Proceedings, 1991, pp. 291-297.

- Hoff, R. 1991. A Summary of Bioremediation Applications Observed at Marine Oil Spills. Report HMRB 91-2. Jan. 1991.
- Mearns, Alan J. 1991. Observations of an Oil Spill Bioremediation Activity in Galveston Bay, Texas. NOAA Technical Memorandum NOS OMA 57. Seattle. Hazardous Materials Response Branch, National Oceanic and Atmospheric Administration. 38 pp.
- MMS Worldwide Tanker Spill Database
- Oil Spill Intelligence Reports XIII.31&SUP,32,33,51
- OSIR International Spill Statistics 1989-1990, Special Report, 3/28/91
- OSIR Oil Spills, International Summary & Review, 1989-1990

Name of Spill: Arabian Gulf/Kuwait
Date of Spill (mmddyy): 01/19/91
Location of Spill: Persian Gulf, Kuwait
Latitude: 29 30 N
Longitude: 048 00 E
Oil Product: Kuwait crude oil
Oil Type: Type 3
Barrels: 900,000,000
Source of Spill: tank vessels, facilities, pipelines, platforms.
Resources at Risk: Power plant water intakes, drinking water intakes, industrial water intakes, mangroves, salt marshes, fine sand beaches, tidal mudflats, coral reefs, fishes, waterfowl, shrimp, shrimp nursery areas, oysters, shorebirds, bird wintering area, bird migratory stopover areas, wading birds, crabs, diving coastal birds, submerged aquatic vegetation.
Dispersants: No
Bioremediation: Yes
In-situ Burning: No
Other Special Interest: Human health and safety concerns, research conducted, volunteer response and organization, wildlife impacts, wildlife rehabilitation.
Shoreline Types Impacted: Mangroves, salt marshes, fine sand beaches, tidal mudflats, coral reefs, submerged aquatic vegetation.
Keywords: Sub-surface oil, side-looking airborne radar (SLAR), skimmers, boom, vacuum truck.

Incident Summary:

Oil was spilled into the Arabian Gulf when the Iraqi Army occupying Kuwait began destroying tankers, oil terminals, and oil wells late in January 1991. Approximately 900,000,000 barrels of oil spilled.

Behavior of Oil:

Approximately *900,000,000 barrels of oil* spilled onto Kuwait lands or into the Arabian Gulf. An estimated third of the total amount of oil released evaporated. Approximately 8,000,000 barrels of oil spilled directly into the Arabian Gulf forming a 600-square mile oil slick. An unknown amount of the oil sank. Four hundred miles of the western shoreline of the gulf was oiled. The areas between Safaniya and Abu Ali Island in Saudi Arabia were the most severely impacted. Tarmats up to 12 inches thick formed on some of these beaches. Over a million barrels of oil were removed from the Arabian Gulf by April 1991 by cleanup operations.

Countermeasures and Mitigation:

While the ongoing war between Iraq and the United Nations Coalition Forces prevented most options for response to the spills, some efforts were made during the war. Most significant was the sealing of open pipelines at the Mina Al Ahmadi facility using smart bombs deployed from Coalition force aircraft. During the war, the United States Coast Guard conducted overflights with SLAR aircraft, and made onshore observations to track the movement of the slick. Postwar efforts were organized by Saudi Arabia's Arabian American Oil Company (ARAMCO), a Saudi owned oil company, the Meteorological and Environmental Protection Administration (MEPA), and the Royal Commission for Jubayl and Yanbu. Firefighting, environmental and biological experts from around the world came to the Middle East to advise on mitigation operations. In Saudi Arabia the initial response concentrated on protecting desalinization plant water intakes. Of primary concern was the plant at Jubayl, which provides the city of Riyadh with 80 per cent of its water. Desalinization, industry and power plant intakes were protected by booms and skimming operations. Sensitive natural areas were also boomed to prevent oiling. Twenty-five miles of boom and 21 skimmers were deployed in the Gulf.

Recovery operations using skimmers, vacuum trucks and booms provided by ARAMCO recovered 1,400,000 barrels of oil from the gulf by April. Oil that collected in coastal depressions was boomed off and skimmed out. Earthen berms were built out from the shoreline to catch oil for skimming. Trenches were dug to collect oil brought in on high tides.

Other Special Interest Issues:

A bird rehabilitation center was set up at Al Jubayl and staffed by Saudi volunteers and Coalition armed forces personnel. An estimated 20,000 birds died from oiling, among them the Socotra Cormorant, which is an *endangered species*, and the Great Cormorant. Thousands of dead crabs were found in the salt marshes, mangroves, and beaches.

Cleanup effectiveness and ecological impact research was conducted in salt marshes by the International Maritime Organization (IMO) and Crowley Maritime Corporation (CMC). Testing of various bioremediation agents and sampling programs for the benthic, pelagic, and planktonic communities of habitats such as mangroves, mudflats, sand beaches, seagrass beds, and coral reefs were initiated by the Research Institute of King Fahd University of Petroleum and Minerals (KFUPM/RI).

References:

- Canby, T.. The Persian Gulf After the Storm. National Geographic. Vol. 180, No. 2. August 1991. pp.2-32.
- Environmental Crisis in the Gulf: The U.S. Response. A booklet produced by the U.S. Gulf Task Force.

Name of Spill: *Aragon*
Date of Spill (mmddyy): 12/29/89
Location of Spill: Madeiran Archipelago, Portugal
Latitude: 33 34 N
Longitude: 015 34 W
Oil Product: Mexican Maya crude oil
Oil Type: Type 3
Barrels: 175,000
Source of Spill: Tank Vessel
Resources at Risk: Seals, beaches, birds.
Dispersants: Yes
Bioremediation: Yes
In-situ Burning: No
Other Special Interest: Logistical or operational problems, interaction with foreign authorities, effects to tourism.
Shoreline Types Impacted: Sand/gravel beaches, exposed rocky shores
Keywords: International Tanker Owners Pollution Federation (ITOPF), boom, high-viscosity screw pumps, high-pressure washing, hot-water flushing, Inipol, reoiling, manual removal, fingerprinting, sub-surface oil, disposal.

Incident Summary:

While under tow, the Spanish tank vessel *Aragon* suffered damage during a storm on December 29, 1989, approximately 360 miles off the coast of Morocco. The damage resulted in the *release of approximately 175,000 barrels of Mexican Maya Crude Oil into the Atlantic Ocean*, near the Madeiran archipelago.

The Portuguese Navy was in charge of the response. They monitored the initial movement of the oil until it made landfall. Approximately three weeks after the spill, pollution occurred on the Portuguese Island of Porto Santo, with oil believed to have been from the *Aragon*. This was later confirmed when oil samples were taken from the vessel.

Portuguese authorities requested assistance from the *International Tanker Owners Pollution Federation (ITOPF)* and the *European Economic Community (EEC) Task Force*. Specialists from the ITOPF and EEC Task Force recommended bringing additional equipment to the island, as there was no pollution response force already in place.

Behavior of Oil:

Mexican Maya oil is a medium crude with an API gravity of 22. The Portuguese Navy observed the oil drifting to the southwest. The oil was difficult to see in the water. Following the initial reporting and tracking, the oil was lost and was believed to have moved below the surface.

Approximately three weeks after the spill, oil impacted the island of Porto Santo. Oil filled five coves on the east side of the island. The oil was held in place by the prevailing winds, although some along shore migration of oil was driven by currents. This caused pollution of the sand beach on the south coast of the island, an important tourist and recreation beach.

A small amount of oil impacted on the rocky shores of the island of Madeira and the Desertas Islands. These islands are sparsely inhabited (only a small research station exists there), but are ecologically sensitive and have large *seabird* and *monk seal populations*. The monk seal is a *threatened species*. Impacts on the Desertas Islands consisted of *scattered tarballs*.

Countermeasures and Mitigation:

There was no response at-sea, as conditions in the area were too rough to use removal equipment. Vessels were unable to get into the coves to facilitate nearshore recovery. All *cleanup* took place from the shoreside and generally consisted of *pumping, manual, and mechanical removal* with any equipment which could be obtained.

Cleanup equipment was flown to Porto Santo from France, Denmark, Germany, and the United Kingdom in heavy transport aircraft. Armed forces personnel unloaded the initial shipments during the night following their arrival, and the equipment was allowed to clear customs quickly so it could be deployed.

Poor access to the shorelines and limited transportation assets on the island hampered the ability of the cleanup personnel to remove the oil. Where access was possible, bulldozers, dump trucks, and backhoes provided effective recovery. *Booms* were used to hold oil against the coves, where it was pumped by *high-viscosity screw pumps* into storage tanks and pits which had been dug to increase the rate of recovery. Recovered bulk oil was stored temporarily in these tanks and pits until it could be carried away for longer term storage. A disused quarry near the port was used for this purpose, but transport of oil there was limited by the number of trucks and the condition of the roads. An estimated 10,000 cubic meters of bulk oil were recovered from Porto Santo.

Once the bulk oil was removed, the shoreline tended to self-clean by wave action. *Dispersants* and *high-pressure, hot-water washing* were used as secondary cleaning for the rocks in the public use areas. After one winter, all

of the residual oil was gone from the beaches, including beaches which had not been cleaned.

Other Special Interest Issues:

Bioremediation was attempted on an experimental basis. *Inipol* was applied at two sites on Porto Santo. Results of the experiments were inconclusive as both sites were in high-energy locations and suffered from *recoiling*.

Oily solids were transported to the landfill near the airfield on Porto Santo and disposed of with the island's domestic refuse. A hydrogeologist from the United Kingdom recommended the action, following an investigation which determined that there would be no risk to the local groundwater. Cleanup personnel excavated proper refuse cells and made the landfill to EEC standards.

Two options were considered for the remaining bulk oil in the quarry. The first was to treat the oil and use it as road foundation. It was decided instead to remove the oil from the island. A Dutch company built a pipeline from the quarry to the port and used specialized pumps to move the heavily emulsified oil directly into a barge. The quarry was cleaned and the oil was shipped to a recycling facility in Amsterdam.

Logistics were a major problem during this response. Very little heavy equipment was available for use and was brought to the island from other locations. Trucks were shipped from Madeira. The spill affected areas which were not accessible to large vehicles. Many roads had to be built or improved on Porto Santo in order to handle the size and number of vehicles used in the response.

The cleanup operation was an international effort. Organizations instrumental in this response included the Portuguese Navy, the International Tanker Owners Pollution Federation, the European Economic Community Task Force (formed by the Commission of European Communities), the governments of France, Germany, the United Kingdom, and the Netherlands. Their efforts were critical to the rapid procurement and proper use of cleanup equipment.

Tourist activity on Porto Santo increased following the spill due to interest in the spill and response activity.

References:

- 08/09/91 & 08/28/91 Letters from Daniel Owen at ITOPF
- Genwest Systems, Inc. communications with ITOPF representatives.
- MMS Worldwide Tanker Spill Database
- Nichols, J.A. and Moller, T.H. 1991. International Cooperation in Oil Spill Response, Oil Spill Conference Proceedings, 1991, pp. 61-64.
- Oil Spill Intelligence Report 01/04/90
- Oil Spill Intelligence Report 01/03/91
- Oil Spill Intelligence Report 02/21/91
- Oil Spill Intelligence Report, International Summary & Review, 1989-1990
- Tanker Advisory Center, Inc. 1991 Guide for the Selection of Tankers. T.A.C. Inc. 1991.

Name of Spill: *ARCO Anchorage*
Date of Spill (mmddyy): 12/21/85
Location of Spill: Port Angeles Harbor, Port Angeles, Washington.
Latitude: 48 07 N
Longitude: 123 27 W
Oil Product: Alaska North Slope crude oil
Oil Type: Type 3
Barrels: 5690
Source of Spill: Tank Vessel
Resources at Risk: National Wildlife Refuges, seals, diving coastal birds, shorebirds, anadromous fish, demersal fish, recreational fishing areas, commercial fisheries, fish aquaculture sites, log storage areas.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Research conducted, unusual or experimental cleanup techniques, wildlife impacts, wildlife rehabilitation, habitat impact due to oil.
Shoreline Types Impacted: coarse gravel beaches, exposed rocky shores, sand/gravel beaches.
Keywords: National Wildlife Refuges, adverse weather conditions, International Bird Rescue and Research Center (IBRRC), volunteers, skimmer, vacuum truck, reoiling, sub-surface oil, Open Water Oil Containment and Recovery System (OWOCS), Air-Deliverable Anti Pollution Transfer Systems (ADAPTS), boom, sorbents, manual removal

Incident Summary:

At 1626 on December 21, 1985 the Tank Vessel *ARCO Anchorage* ran aground while anchoring in Port Angeles Harbor, Washington. The vessel was carrying 814,000 barrels of *Alaska North Slope crude oil* en route from Valdez, Alaska to the Cherry Point Refinery in Bellingham, Washington. Weather conditions at the time of the incident were calm with a visibility of 3 miles. The vessel was holed in two cargo tanks resulting in the loss of 5690 barrels of oil into Port Angeles Harbor. Internal transfer of cargo from the holed tanks stopped the discharge of oil into the water by 2052, December 21. The *ARCO Anchorage* remained aground until 0244, December 22 when it was refloated and moved to deeper anchorage within Port Angeles Harbor.

Through discussions with the Canadian Coast Guard it was decided that invocation of the joint U.S. Canadian response plan (CANUSPAC) was not necessary, but that close contact would be maintained. An ARCO spill response team was activated from Long Beach, California. Under the influence of wind and tides, the oil was carried to the west almost to Neah Bay and to the east to Dungeness Spit. No impacts were observed in Canada from this incident. Cleanup activities were suspended on April 7, 1986.

Behavior of Oil:

Alaska North Slope crude oil is a medium weight oil with an API gravity of 26.5 and a pour point of 0 degrees F. Shortly after the grounding, released oil was observed bubbling from under the port side of the vessel in the vicinity of the No. 4 and 5 tanks. Due to light wind conditions and calm seas, the movement of oil was primarily directed by tidal current influences. Movement of oil within the harbor was generally in a clockwise direction. Oil was carried out of the harbor around the end of Ediz Hook as well as to the east from the vessel itself. Most of the oil that left Port Angeles Harbor was carried to the east and west along the ten fathom contour. Heavy concentrations of oil were observed to the east of the harbor immediately north and northeast of Dungeness Spit. The slick stalled in this area for nearly two weeks before the remaining patches began to move in a westerly direction. Scattered slicks and sheens of emulsified oil were observed to the west of Port Angeles as far as Neah Bay. Some patches of brown oil were observed between Angeles Point and Agate Bay.

Impacted areas within Port Angeles Harbor included the oiling of 15 million board feet of *wet stored logs* and the shoreline oiling of approximately 7,000 feet of coarse grain, cobble beach along Ediz Hook. Shoreline areas 15 miles to the east of Port Angeles at Dungeness Spit were only lightly impacted with oil despite heavier concentrations offshore. During the first two weeks of the spill, the bird populations in the Dungeness Spit area were impacted by both beached oil and the offshore slick. Seals were seen in the area. One dead animal which was recovered was determined to have died of non-oil related causes. The inner lagoon at Sequim Bay was not affected; occasional reports of oiling proved to be detritus. To the west of Port Angeles some light oiling of shoreline was reported at Crescent Bay, Little Agate Bay, Freshwater Bay, and Pillar Point.

Countermeasures and Mitigation:

By 2125 on the night of the incident, 4,500 feet of containment boom had been deployed from Coast Guard, Clean Sound and Western Tug and Transport storage facilities. Numerous vessels were dispatched to contain the oil around the vessel. When the extent of the spill was realized, an additional contractor, Crowley Environmental, was brought on-scene. A total of 9 *skimmers and 15 spill response vessels were ultimately used*, including some Canadian vessels from Burrard Clean. Open water recovery efforts were hampered by *fog which prevented spill overflights. All skimmers working offshore had to be equipped with radar.* Calm seas provided ideal conditions for skimming operations. By developing an active communications system and learning to predict local currents, operators were able to keep the skimmers in recoverable concentrations of oil. When away from recoverable oil, skimmer operators would start a systematic search, and contact other vessels for redeployment if oil was not found. *Skimmers using this system were able to operate continuously, 24 hours a day, for five weeks.* An important element in this operation was the contracting of Foss Marine and Wight Marine Service to provide on-scene mechanical and electrical repair to any vessel around the clock. Of the 5,700 barrels of oil spilled, *an estimated 3,126 barrels were recovered.*

The cleanup of 15 million board feet of *oiled logs* posed a unique challenge. Five million board feet were considered lightly oiled and were cleaned by dragging the logs through a car wash and cleaning with high pressure fire hoses. The remaining 10 million board feet (2,300 bundles of 10-20 logs each) were heavily oiled and had to be removed from the water for cleaning. A complete logging operation had to be established. Three barges equipped with cranes were contracted from Seaspan Corp. of Canada to lift the log bundles out of the water, load and transport the logs for cleaning, and finally dump the logs back into the water after cleaning. *The bundles of logs were cleaned by dipping the bundles under water three or four times to release trapped oil and then washing with high pressure water cannons* aboard two Foss tugs. Global Diving and Salvage was also contracted to assist in log cleanup. The log cleaning operation was completed on January 29.

Reidel Environmental was contracted to cleanup impacted beaches to the west at Crescent Bay, Agate Bay, and Freshwater Bay. Cleanup activities on these lightly impacted beaches consisted of the removal of floating oil using sorbents, debris removal, and wiping of logs and rocks. Volunteers were dispatched to several areas to recover oiled birds and to take samples of kelp and sea urchins. Samples analyzed by Battelle Pacific Northwest found no tainting of sea urchins. Western cleanup activities were completed by January 10 and a survey by Washington Department of Ecology (WDOE) personnel sighted no oil on January 16.

Cleanup activities along the Dungeness Spit beaches were under the direction of the Refuge Manager. Cleanup recommendations were agreed upon and set forth in writing. WDOE arranged to have the Washington State

Conservation Corps remove oiled debris for ARCO. Logs were not removed from the beaches because of their contribution to the stability of the spit. By December 29, consensus among the NOAA, WDOE, U.S. Fish and Wildlife Service (FWS), and the OSC was reached concerning the detrimental effects of further cleanup activities. On January 7 all parties agreed that further cleanup of Dungeness Spit would be suspended and that a final evaluation of the area's condition would be made in April. On April 26, 1986, an inspection of the spit at low tide was made by the Coast Guard, SSC, FWS, ARCO, WDOE, and Clallam County. The beach was declared "clean" and ARCO was released from any further cleanup responsibility.

Other Special Interest Issues:

Discussions regarding dispersant use were opened during the second day of the spill. *Dispersant use was ruled out due to the oil movement toward environmentally sensitive areas*, weathering of the oil, uncommonly calm seas, and the fear that authorization for dispersant use would take too long.

A monitoring program was established to include sampling of sediments for three years, or until sediment hydrocarbon levels were reduced to background levels. Samples taken at Ediz Hook four months after cleanup operations were terminated showed decreased concentrations of oil in the sediments as well as some evidence of biological recovery.

The beaches along Ediz Hook adjacent to the log storage area were being cleaned concurrently with the log operation. Crowley Environmental Services was contracted to conduct beach cleanup involving *vacuum trucks*, rope mops, and sorbents. After an occurrence of heavy weather the cleaned areas were reoiled and it was assumed that the logs were the likely source. When the *recoiling* occurred again after most of the logs had been cleaned, another source of oil was sought. *Fresh, unweathered oil was found 2-3 in. below the surface of the cobble and sand beach* in a oil saturated layer of sand 4-6 in. thick. Since the oil was unweathered it was determined that agitation of the sediments below the water would float the fresh oil free. *Several mechanical agitators were designed using high pressure water nozzles*. The most effective employed a bulldozer equipped with rippers and hydraulic nozzles fitted behind each ripper. The combination of the mechanical and hydraulic agitation proved to be fast and efficient. A 3,000 to 6,000 square yard section of beach was isolated with containment booms on three sides and sorbent sweeps placed three deep in the surf zone. The bulldozers worked parallel to shore with the tide to keep the rippers submerged.

Beach cleaning continued 16 hours a day, six days a week, for nearly six weeks. Recovery estimates were as much as 50 barrels per 100 yards of beach with tests showing a recovery rate near 67%. Cleanup operations were suspended on April 7, 1986 after it was decided that further mechanical efforts to recover oil would not be productive nor environmentally advisable.

Throughout the spill, efforts to rescue, clean, and rehabilitate oiled birds were carried out under the direction of the *International Bird Rescue Research Center*. A total of 1,917 oiled birds were recovered. Of these, 1,560 were treated by over 2,000 volunteers. Results of the bird rehabilitation were low compared to other spills. Reasons for the disappointing results were suggested to be the huge number of birds received over a short period of time as well as quality control and variation in the cleaning techniques used by volunteers. A recommendation for future spills was that volunteers not be used for bird cleaning. *Volunteers can probably be used more effectively to recover birds from the field* while an organized labor force, such as the Washington Conservation Corps., under close supervision by specialists, would produce better results in cleaning and overall care of recovered birds.

A salmon aquaculture operation in Port Angeles Harbor was boomed, but was still oiled. There was no mortality to fish, but feeding was suspended until oil was cleaned up with sorbents. All cages, nets, and catwalks were replaced by ARCO.

References:

- Blaylock, W.M. and Houghton, J.P. 1989. Infaunal Recovery at Ediz Hook Following the ARCO ANCHORAGE Oil Spill. The Physical Persistence of Spilled Oil: An Analysis of Oil Spills Previous to Exxon Valdez. Final Report. HAZMAT. OAD. NOAA. pp. A162-A168.
- Gundlach, E. and Marshall, M. 1990. The Physical Persistence of Spilled Oil: An Analysis of Oil Spills Previous to Exxon Valdez. Final Report. HAZMAT. OAD. NOAA. pp. 47-68.
- Levine, Robert A. 1987. Operational aspects of the response to the ARCO Anchorage oil spill, Port Angeles, Washington, Oil Spill Conference Proceedings, 1987, pp.3-7.
- Lindstedt-Siva, June et al. 1987. Environmental aspects of the ARCO Anchorage oil spill, Port Angeles, Washington, Oil Spill Conference Proceedings, 1987, pp.407-410.
- Miller, J.A. 1989. Physical and Chemical Recovery of Intertidal and Shallow Subtidal Sediments Impacted by the ARCO ANCHORAGE Oil Spill, Ediz Hook, Washington. Oil Spill Conference Proceedings 1989, pp.487-491.
- Miller, James A. 1987. Beach agitation for crude oil removal from intertidal beach sediments. Oil Spill Conference Proceedings 1987, pp.85-90.
- NOAA Oil and hazardous materials response reports FY86.
- NOAA Response Report.
- OSIR Oil Spills, International Summary and Review, 1982-1985
- Review of Oil Spill Occurrences and Impacts, Exxon Production Research Company, 1989.
- USCG Federal On-Scene Coordinators Report.

Name of Spill: *Argo Merchant*
Date of Spill (mmddyy): 12/15/76
Location of Spill: 29 miles southeast of Nantucket Island, Massachusetts
Latitude: 41 02 N
Longitude: 069 27 W
Oil Product: No. 6 Fuel Oil, cutter stock
Oil Type: Type 4
Barrels: 183,000
Source of Spill: Tank Vessel
Resources at Risk: Commercial fisheries, fish, diving coastal birds, gulls, marine mammals.
Dispersants: No
Bioremediation: No
In-situ Burning: Yes
Other Special Interest: Research conducted, wildlife impacts, wildlife rehabilitation, adverse weather conditions, media interest.
Shoreline Types Impacted:
Keywords: Drift cards, Air-Deliverable Anti-Pollution Transfer System (ADAPTS), fingerprinting, sinking.

Incident Summary:

At approximately 0600 on December 15, 1976, the Liberian tanker *Argo Merchant* went aground on Fishing Rip (Nantucket Shoals), 29 nautical miles southeast of Nantucket Island, Massachusetts in high winds and ten foot seas. The vessel was carrying approximately 183,000 barrels of *No. 6 fuel oil* (80%) and *cutter stock* (20%). The master of the *Argo Merchant* requested permission to dump cargo in an effort to control draft and re-float the vessel. Permission was denied and attempts to lighten and re-float the vessel using emergency pumps and an Air Deliverable Anti-Pollution Transfer System (ADAPTS) were unsuccessful. The following day the weather worsened and the crew of the *Argo Merchant* was evacuated. On December 17 the vessel began to pivot clockwise and buckle. On December 21 the vessel broke in two aft of the king post, spilling approximately 36,000 barrels of cargo. The bow section split forward of the bridge and capsized on December 22, resulting in the loss of the remaining cargo. The bow section floated 400-500 yards to the southeast and was eventually sunk by the USCG while the stern section remained aground. Prevailing currents carried the spilled oil away from the shorelines and beaches of Nantucket. Weather conditions and uncharted depths surrounding the wreck made salvage attempts difficult.

Behavior of Oil:

No. 6 fuel oil is a heavy product with an API gravity that ranges from 7 to 14. The bulk of the spill formed large pancakes (largest observed was 240 feet by 760 feet) and sheens on the surface. Inspection of the pancakes by divers revealed flat bottoms. Fresh oil formed pancakes 1-1.5 inches thick with tiered edges. The pancakes thickened as the oil aged, some heavily weathered pancakes up to 10 inches thick were observed. The weathered pancakes lacked tiered edges and associated sheens. The cutter stock, which was mixed with the fuel oil to improve handling, entered the water column. Levels as high as 250 parts per billion were measured beneath areas of fresh oil.

Extensive efforts were made to monitor and track the spill. Detailed mapping was undertaken due to the level of concern, potential impacts, and to help develop more accurate trajectory models for future spills. Multiple trajectory models were utilized and evaluated during the incident. Accurate measurements of the speed of the spill revealed that oil in pancakes traveled at an average speed of about 1.1% of the wind speed, and the sheens somewhat slower. The spill moved to the south-southeast of the wreck site, out over the continental shelf, and into the prevailing North Atlantic circulation pattern. As the oil moved further offshore, wind direction and weather conditions became less of a concern. *Six thousand drift cards* were deployed between the spill and the coast in an attempt to give advance warning at locations of imminent shoreline impacts.

Large tar balls (up to 70 pounds) came ashore in the Nantucket area during March of 1977. Analysis of the oil confirmed that it was No. 6 Fuel Oil, but it could not be directly identified as product from the *Argo Merchant*.

Some impacts to the bottom sediments were observed in the area of the sunken bow section of the vessel. In addition to this localized area, one sediment sample taken from the area of the spill showed oil contamination.

Countermeasures and Mitigation:

In-situ burning was attempted on two occasions. The material used was composed of fine grained, fumed silica particles treated with silane to render the material hydrophobic. Originally marketed as CAB-O-SIL ST-2-0, the product was later marketed under the trade name *Tullanox 500*.

In the first burning attempt, conducted on December 27, a USCG helicopter dropped isolated boxes of Tullanox 500 charged with *JP-4 jet fuel* onto the oil and ignited the boxes using a timed grenade. The isolated boxes burned, but the flame failed to spread. It was believed that the wicking agent was not sufficiently dispersed to allow spreading of the flames.

The second attempt was conducted on December 31. The USCG vessel *Spar*, aided by aircraft, located a 90 foot by 120 foot elliptically shaped slick that was of a heavy, tarry consistency, and 6 to 8 feet thick. The slick broke into smaller pancakes as the *Spar*

maneuvered alongside. Sixty-six pounds of Tullanox 500, in 11 pound bags, were thrown near the center of a 30 foot by 60 foot slick. The bags were torn open and much of the material was blown off of the slick. Another application of six bags was applied along the edge of the slick and charged with JP-4. *The experiment was terminated after attempts to ignite the slick failed to sustain a burn.*

Other Special Interest Issues:

Due to the offshore movement of the spill, concern for resources shifted from potential shoreline impacts to the economically important fishing grounds in the area of Georges Bank. Benthic fish and invertebrate populations and their associated planktonic stages were at risk. Evidence of oil contamination was observed in fish, shellfish, ichthyoplankton and zooplankton collected in the area of the spill. Mortalities of Cod and Pollack embryos occurred in eggs contaminated with oil, and large numbers of zooplankton were observed to be contaminated with hydrocarbons. A decline in the population of Sandlance, an important prey species, was reported during and following the spill, however, the decrease in numbers of Sandlance could not be directly attributed to the spill.

Observers aboard vessels in the area reported that 25 to 75% of the seabirds seen were fouled with oil. Fouling was observed mostly on the breast and abdominal areas. Herring Gulls and Black-backed Gulls appeared to be the most heavily impacted. Many boats in the area of the spill reported heavily oiled gulls landing on-board their vessels. The birds often appeared weak and overly tame. Diving birds that were reported oiled included Gannets and murre, but few of these species were observed to be heavily oiled. A total of 43 marine mammals were observed in the area of the spill, but none were in obvious distress or in direct contact with oil pancakes or sheens.

The grounding of the *Argo Merchant* initiated intense scientific activity between December 15 and February 12. Studies related to the fate and effects of the oil as well as the modeling of trajectories were conducted to begin the process of assessing ecological impacts.

Shortly after the grounding, research vessels from NOAA and Woods Hole Oceanographic Institute (WHOI) were diverted from their scheduled itineraries to begin special operations concerned with the fate and effects of the spilled oil. Personnel from National Marine Fisheries Service (NMFS), WHOI and NOAA aboard two vessels began assessment of water column contamination. Cruises involving USCG, NOAA, WHOI, U.S. Geological Survey, and University of Rhode Island (URI) vessels collected more than 200 water and sediment samples. Fish and shellfish samples were collected at 43 biological stations during a subsequent NMFS cruise. Benthic sampling was conducted throughout the area of the continental shelf over which the oil spill passed on two cruises by personnel from URI, NOAA, and the USCG.

Considerable credit for the success of the research operation was attributed to the Federal On-Scene Coordinator's efforts to combine the research activities rather than allowing fragmentation of the effort. The OSC was also responsible for making operational resources, such as aircraft and vessels, available for research purposes.

Media attention during the *Argo Merchant* spill was considerable. Though the oil never impacted the coast, public perception a year after the spill was that widespread and serious damage had occurred. The USCG was the target of increasing criticism during the incident. Criticism of the Coast Guard's handling of the incident was noted at a U.S. Senate hearing. A problem of conflicting information had developed due to the release of information from two different sources, the district office and the Coast Guard air station. After the two command posts were consolidated, public information problems were minimized.

Shore-based cleanup of oiled seabirds was funded by the OSC under the direction of the Massachusetts Division of Fisheries and Wildlife. A total of 160 oiled birds were recovered. The relatively low number of birds collected was attributed to the winter conditions and the scarcity of beach patrols. Oiled birds were recovered as far away as Dartmouth, Nova Scotia. A total of 47 birds were released after cleaning at either the Sandwich, Massachusetts, or Felix Neck Audubon Society facilities. Although oiling of gulls was the most commonly observed impact in the spill area, Common Murres were the most common birds recovered from the beaches.

References:

- 1991 World Almanac
- 8/9/91 & 8/28/91 Letters from Daniel Owen at ITOPF
- Hooke, N. Modern Shipping Disasters 1963-1987. Lloyds of London Press. 1987.
- Meidt, R.M. 1987. On-scene coordinators can effectively inform the public through the news media. Oil Spill Conference Proceedings, 1987, pp. 583-585.
- MMS Worldwide Tanker Spill Database
- Rappaport, et al. 1981. The media and oil spills: Does the press influence damage perceptions, Oil Spill Conference Proceedings, 1981, pp. 707-712.
- Review of Oil Spill Occurrences and Impacts, Exxon Production Research Company, 1989.
- Tanker Advisory Center, Inc. 1991 Guide for the Selection of Tankers. T.A.C. Inc. 1991.
- The Argo Merchant Oil Spill, a Preliminary Scientific Report, NOAA, March 1977
- The socioeconomic Impacts of Oil Spills, Final Report, WAPORA, March 1984.
- USCG Pollution Incident Case Analysis of the Argo Merchant.

Name of Spill: *Arrow*
Date of Spill (mmddyy): 02/04/70
Location of Spill: Nova Scotia, Canada
Latitude: 45 28 N
Longitude: 061 06 W
Oil Product: Bunker C Oil
Oil Type: Type 4
Barrels: 77,000
Source of Spill: Tank Vessel
Resources at Risk: Commercial fishing areas, soft shelled clams, lobsters, scallops, lobster fisheries, fish processing plants, seals, gulls, petrels, fulmars, waterfowl, wading birds, alcids, recreational beaches.
Dispersants: Yes
Bioremediation: No
In-situ Burning: Yes
Other Special Interest: Wildlife impacts, adverse weather conditions, research conducted.
Shoreline Types Impacted: Mixed sediment beaches, sand and gravel beaches, exposed rocky shores.
Keywords: Steam generators, suction operations, Corexit 8666, manual removal, sinking, sorbents, boom.

Incident Summary:

On February 4, 1970, at 0935, the steam tanker *Arrow* ran hard aground on Cerberus Rock in Chedabucto Bay off the coast of Nova Scotia, Canada. The vessel had been traveling off course at nearly full speed when the grounding occurred. The *Arrow* broke into two pieces on February 12, spilling between 77,000 and 82,500 barrels of Bunker C Oil into the waters of the bay. Visibility at the time of the grounding was between five and six miles, water temperatures were very cold and there was ice in the bays and inlets. There were high winds and seas at the time of the spill. This worked to spread the oil into Chedabucto Bay, and the oil eventually impacted *approximately 300 kilometers of the bay's shoreline.*

Behavior of Oil:

Bunker C fuel oil is a heavy product with an API gravity that ranges from 7 to 14. Oil near the spill site took the form of rainbow, silver and dull sheen. Oil was also visible in the water in the form of chunks, which were described as "the size of a hand towel, rolled lengthwise." Oil at the spill site was observed as a long narrow slick extending to the east. This pattern was seen usually during periods of calm or light winds.

Oil moved under the influence of tides and currents and impacted the shoreline generally between the mid and high tide line. In some cases, the oil was driven above the high tide line by storms. In Chedabucto Bay, approximately 300 kilometers of shoreline were oiled ranging from a trace to very heavy coverage. In the lagoons and other low-energy locations, the oil mixed with sand and weeds. The north and west shores of the bay were heavily oiled and formed a tar-like mix of Bunker C and sediment.

Oiled shorelines in high-energy locations were cleaned by natural processes within two to three years. Only traces of oil and no apparent damage to the ecosystem could be found in long-term studies of these areas. In low energy locations, such as Black Duck Cove and Janvrin Lagoon, damage to the ecosystem was still visible and *the amount of oil on the shoreline remained relatively unchanged over seven years later.*

Countermeasures and Mitigation:

Large oil slicks were dispersed by wave action and *chemical dispersants*. Ten tons of the dispersant *Corexit 8666* were applied to large portions of the oil.

Oiled wharves and boats were cleaned with steam. *Steam cleaning* in this case was the best alternative, as it required no solvents or detergents, provided portability, required little maintenance and support, and could be used by crews of unskilled laborers. The oil removed during cleaning was absorbed by peat moss placed in the water and recovered with *slick lickers*, an *oleophilic-belt type skimming system*. These were used at various locations during the cleanup and were very effective at removing high viscosity oil.

Oil remained for the longest time on the sheltered mixed sand and gravel beaches. Cleanup of these areas was performed by both manual and mechanical means. *Mechanical equipment in these areas caused damage to the back of the beach and mixed oil deeper into the sand than it had been.* Scrapers were not effective on the coarse gravel beaches, and only somewhat effective on the compact sand beaches. *Oil was still visible to observers ten years after the spill in some of the sheltered areas.*

Other Special Interest Issues:

Remaining cargo was removed from the stern section of the sunken vessel by *hot-tapping* in approximately ninety feet of water. Pumping operations began on March 2 and were concluded on April 11. Two boilers installed on the recovery barge were used to heat the cargo. Approximately thirty-seven thousand barrels of oil and emulsified oil and water were removed from the *Arrow*. The extremely adverse weather conditions, including snow, ice, high seas and gale-force winds, added to the difficulty of these operations.

The scientific coordination team set up *a large laundromat for cleaning oiled fishing nets*. This cost approximately \$22,000, but saved considerable time and

money over replacing all the oiled fishing nets. These nets cost approximately twenty-five thousand dollars each.

Experiments were conducted during the spill to test the effectiveness of various natural sorbents and burning operations. At several sites in Chedabucto Bay, *peat moss* was tested as an absorbent. Peat moss was spread on the beach and oil was allowed to wash over it, or was forced onto it with booms. The peat moss would stick to the oil and the mixture could be easily removed with a rake. The peat moss was found to be very effective as an absorbent for Bunker C oil on sand beaches. Its ability to absorb decreased as the oil weathered and formed a water-in-oil emulsion. *An experiment involving steam cleaning* was performed at a test site that had not previously been oiled. Rocks were purposefully covered with oil and then steam cleaned. The oil ran onto peat moss that was being held by boom to keep it from moving downstream, and to prevent further contamination of the area.

In-situ burning experiments were conducted on two-inch thick patches of oil that had been exposed to the water for more than two weeks. In two separate sites, peat moss was used as a wick, and fuel (gasoline or turbofuel) was used to start the fire burning. Results of both tests were negative. This is believed to be due to the amount of weathering that had already taken place.

On February 14, 1970, only ten days after the grounding of the *Arrow*, an oil barge called the *Irving Whale* spilled between 100 and 200 barrels of Bunker C oil off the southeast coast of *Newfoundland*. This barge was later used to receive oil pumped from the *Arrow* during the salvage and lightering operations. (The *Irving Whale* sank off the northern coast of Prince Edward Island in July 1970 with a cargo of Bunker C aboard.) The spill from the *Irving Whale* is estimated to have caused the *deaths of at least 5,500 birds* along the southern coast of Newfoundland.

Both the *Irving Whale* and the *Arrow* caused the deaths of a large number of birds. The two spills caused the *known deaths of 1,500 ducks and seabirds, and deaths of an estimated 12,000 birds.*

References:

- Brown et al. 1973. Bird Mortality from Slicks off Eastern Canada, February-April 1970. Canadian Field-Naturalist 87: 225-234.
- Canadian Ministry of Transport. Report of the Task Force-Operation Oil (Cleanup of the Arrow Spill in Chedabucto Bay). 1970.
- Environment Canada. 1982. Oil and Dispersants in Canadian Seas-Research and Appraisal Recommendations.
- Hooke, N. Modern Shipping Disasters 1963-1987. Lloyds of London Press. 1987.
- Mostert, N. Supership. 1974.
- Report of the Royal Commission. Pollution of Canadian Waters by Oil and Formal Investigation into Grounding of Steam Tanker "Arrow." 1970.
- Review of Oil Spill Occurrences and Impacts, Exxon Production Research Company, 1989.
- Tanker Advisory Center, Inc. 1991 Guide for the Selection of Tankers. T.A.C. Inc. 1991.
- Wilson, M.P. Jr., et al., "The Spreading, Retention and Clean-up of Oil Spills," URI, Kingston, RI, 1976.

Name of Spill: Ashland Petroleum Company
Date of Spill (mmddyy): 01/02/88
Location of Spill: Monongahela River, West Elizabeth, Pennsylvania
Latitude: 40 33 N
Longitude: 080 00 W
Oil Product: diesel fuel
Oil Type: Type 2
Barrels: 23,810
Source of Spill: Facility
Resources at Risk: Waterfowl, fish, mustelids, drinking water intakes.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Logistical or operational problems, adverse weather conditions, closure of shipping lanes or vehicle traffic routes, human health and safety concerns, wildlife impacts, wildlife rehabilitation.
Shoreline Types Impacted: Vegetated riverbank, riprap, levees.

Keywords: Boom, skimmer, vacuum truck, sorbents.

Incident Summary:

On January 2, 1988, a 40 year old storage tank collapsed at the Ashland Oil Facility in West Elizabeth, Pennsylvania. The tank collapse spilled 90,476 barrels of diesel fuel, 23,810 barrels of which flowed into the Monongahela River 27 miles south of Pittsburgh, Pennsylvania. As the spill moved downriver, water supplies were contaminated, resulting in the disruption of water services to riverside cities in Pennsylvania, Ohio, and West Virginia.

Behavior of Oil:

The slick flowed past Pittsburgh where the Monongahela and the Allegheny rivers meet to form the Ohio River. By January 4, traces of oil reached Newell, West Virginia 92 miles downstream from the spill site. By January 10, the oil had flowed past Steubenville, Ohio, and reached Wheeling, West Virginia. By January 13, the spill had traveled 130 miles down the Monongahela and Ohio rivers to reach Sisterville, West Virginia. Ice flows in the rivers delayed the passage of the slick downstream. A National Oceanic and Atmospheric Administration (NOAA) study suggested that there would be minimal re-release of product due to oil being incorporated into the ice.

Countermeasures and Mitigation:

The Coast Guard deployed booms at seven sites along the river near Pittsburgh. Barges pushed by tugboats herded the oil behind the booms toward the shore where vacuum trucks picked it up. Skimmers and sorbents were used in other areas along the river. Small booms were placed on the Monongahela River in an attempt to deflect the oil away from water intakes. By January 7, only 1,905 barrels of product had been recovered. The effort to recover the oil was hindered by emulsification and dispersion of the oil with the water. A 50-75% ice cover on the Monongahela and Ohio Rivers hindered the recovery of product. Efforts along the Ohio River were additionally hindered by the presence of dams and locks.

The Pennsylvania Game Commission set up bird cleaning programs. As of January 7, one goose was listed as an oil spill fatality and fish mortalities were in the hundreds.

The response lasted for two weeks following the incident.

Other Special Interest Issues:

The Coast Guard closed the Monongahela River to vessel traffic between the Ashland facility in West Elizabeth and Pittsburgh. Rail and motor vehicle traffic was halted along some routes near the river, due to concerns about human health and fire hazards.

Water service to 22,000 homes in Pittsburgh was turned off on January 4 and wasn't completely turned on again until January 10. In Steubenville, Ohio all nonessential businesses were closed with water service interrupted for three days.

References:

- 1,200 Flee After Spill on River. The Seattle Times. January 3, 1988. p.A2.
- Diesel Oil Slick Reaches Wheelin, W.Va.; Citizens Urged to Conserve Water. The Seattle Times. January 10, 1988. p.A2.
- More Towns Prepare as Diesel-fuel Spill Moves Downstream. The Seattle Times. January 7, 1988. p.A2.
- Oil Imperils Water in Two More States. Seattle Post-Intelligencer. January 7, 1988. p.A3.
- Oil Slick Threatens More Cities along Pathway of Disaster. The Seattle Times. January 13, 1988. p.B6.
- Oil Spill Cuts Water Supply to Thousands West of Pittsburgh. Seattle Post-Intelligencer. January 5, 1988. p.A1.
- Oil Spill Shuts Off Water to Thousands. The Seattle Times. January 10, 1988. p.A3.
- Oil Spill Will Disperse in Next 2 Weeks, Experts Says. Seattle Post-Intelligencer. January 13, 1988. p.A4.
- Spill Dries Spigots; Supplies Scarce. The Seattle Times. January 5, 1988. p.2.
- They Cope Without the Water. Seattle Post-Intelligencer. January 6, 1988. p.A3.
- Workers Race to Contain Oil Spill. The Seattle Times. January 4, 1988. p.A10.

Name of Spill: *Assimi*
Date of Spill (mmddyy): 01/07/83
Location of Spill: Oman
Latitude: 22 46.7 N
Longitude: 062 51.5 E
Oil Product: Light Iranian Crude Oil
Oil Type: Type 2
Barrels: 379,000
Source of Spill: Tank Vessel
Resources at Risk: Power plant water intakes, drinking water intakes, beaches, commercial fisheries, coral reefs, mangroves, river estuaries, coastal lagoons.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Logistical or operational problems.
Shoreline Types Impacted:
Keywords: International Tanker Owners Pollution Federation Ltd. (ITOPF), fire, explosion, sinking.

Incident Summary:

On January 7, 1983, a fire broke out in the engine room of the tanker *Assimi*. The crew abandoned ship and the *Assimi* was taken under tow by the tug *Solano*. On January 10, an explosion occurred aboard the vessel and it burned fiercely for several days as it was towed into the Arabian Sea. The tanker was towed to a point 200 miles off the coast of Oman where it sank on January 16. A second explosion occurred as the vessel was sinking which ignited the oil on the surface of the water. A slick formed above the area where the vessel sank. There was no coastal pollution resulting from the incident.

Behavior of Oil:

Light Iranian crude oil is a medium weight product with an API gravity of 33.8 and a viscosity of 6.6 centistokes. An overflight on January 19 revealed a slick of silver sheen in the vicinity of the sinking covering 100 square miles and moving towards the northeast. Personnel on an overflight on January 22 found some fresh oil in the slick. The older oil had emulsified, and the total area of the slick was reduced. The northernmost edge of the slick was 180 miles off the coast of Pakistan. An overflight on February 4 showed that most of the oil had dispersed.

Countermeasures and Mitigation:

The government of Oman convened a council that included representatives from the Council for Conservation of the Environment and Prevention of Pollution (CCEPP), Sultanate of Oman Navy (SON), Sultanate of Oman Air Force (SOAF), the Royal Oman Police (Marine), the Maritime Affairs Department, the Ministry of Petroleum and Minerals, and the petroleum industry. The council was to form a response strategy in the event of a release of oil. International Tanker Owners Pollution Federation Ltd. (ITOPF) and Smit International were asked to provide expertise, and representatives from those organizations arrived in Oman on January 12. International Transport Company Contractors, the salvors of the *Assimi*, contracted Smit International to help fight the fire. Equipment and personnel from Smit fought the fire using water and foam from their tug *Smit Pioneer*. On January 11, the fire was still burning, and the firefighters flooded the pump room in an attempt to keep the fire from spreading from the engine room to the cargo tanks.

The government of Oman contacted the Gulf Area Oil Companies Mutual Aid Organization (GAOCMAO) to provide an aircraft with dispersant spraying capabilities. Vessels from the Sultanate of Oman Navy (SON), were equipped with booms and dispersants. Dispersants were obtained from Saudi Arabia and Dubai to supplement the stock of Petroleum Development Oman (PDO). No dispersants were applied, because the oil was observed to dissipate rapidly.

The vessel began to sink while under tow by the *Solano*, and the Oman government ordered the salvors to tow the vessel to a point 200 miles from the coast of Oman and sink it. On January 16, the *Assimi* was sunk at 22°43' N, 63°58' E in 3000 meters of water. An explosion occurred as the vessel sank and a slick of burning oil formed on the surface.

The International Maritime Organization (IMO) was contacted to assess the threat to environment and make recommendations to the Oman council. The council also contacted the Regional Organization for the Protection of the Marine Environment (ROPME) to provide expertise. Observers of the sinking suggested that the oil released by the breakup had burned on site. The IMO and ROPME representatives advised further overflights to determine if the tanker was still leaking oil.

An overflight on January 19 revealed a slick of silver sheen covering 100 square miles and moving towards the northeast. The government of Pakistan was notified that the slick was heading towards their coast. An overflight on January 22 found fresh oil on the surface near the sinking. The older oil had emulsified, and the total area of the slick was reduced. The northernmost edge of the slick was 180 miles off the coast of Pakistan. An overflight on February 4 showed that most of the oil had dispersed.

Other Special Interest Issues:

The *Assimi* originally caught fire on January 7, and attempts were made to extinguish the fire. After an explosion on January 10 the fire was burning more fiercely. The salvors of the vessel were refused passage through the Straits of Hormuz. On January 12 the tow had been let go due to fears that the fire could flash back, however, the *Solano* was able to reconnect the tow and pull the *Assimi* even further from the coast.

An expert from the Food and Agriculture Organization (FAO) of the United Nations arrived in Oman on January 21 to determine the risk to fisheries in the Arabian Sea. The FAO representative reported that a spill that far from the coast would not affect the fisheries.

References:

- 8/9/91 & 8/28/91 Letters from Daniel Owen at ITOPF
- Genwest Systems, Inc. communications with ITOPF representatives.
- Hayes, T.M. 1985. The Tanker *Assimi* - A Case History. Oil Spill Conference Proceedings 1985. pp. 307-310.
- MMS Worldwide Tanker Spill Database
- OSIR Newsletter 2/21/91
- OSIR Oil Spills, International Summary & Review, 1982-1985
- Tanker Advisory Center, Inc. 1991 Guide for the Selection of Tankers. T.A.C. Inc. 1991.

Name of Spill: *Athenian Venture*
Date of Spill (mmddyy): 04/22/88
Location of Spill: Canada, southeast of Cape Race, Newfoundland
Latitude: 42 30 N
Longitude: 049 30 W
Oil Product: Unleaded Gasoline
Oil Type: Type 1
Barrels: 252,429
Source of Spill: Tank Vessel
Resources at Risk:
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest:
Shoreline Types Impacted:
Keywords: Explosion, fire, sinking, evaporation.

Incident Summary:

Early on April 22, 1988, the tanker *Athenian Venture* was found by the Canadian research vessel *Hudson* 400 miles southeast of Cape Race, Newfoundland. The *Athenian Venture* had apparently experienced a violent explosion as it was broken in two and on fire. The *Athenian Venture* had been en route from Amsterdam, Netherlands, to New York, New York, with a cargo of approximately 250,000 barrels of unleaded gasoline on board. The vessel was drifting at 40 38 N, 051 09 W, and the bow and aft sections were approximately two miles apart when found. The bow section sank at 1400 on April 22. The aft section continued to drift on fire for the next 7 weeks, finally sinking on June 17 about 200 miles from the Azores.

Behavior of Oil:

Automotive gasoline is a very light weight, refined product with an API gravity of 60 to 63. Overflights on April 22 discovered a slick .5 by 4 miles. However, most of the gasoline burned in the extensive fires. The remaining oil dissipated very rapidly, most of which was lost to evaporation. Weather conditions immediately following the accident were good, with high visibility and calm seas.

Countermeasures and Mitigation:

No countermeasures were undertaken.

Other Special Interest Issues:

The USCG coordinated rescue efforts with the Canadian Coast Guard. Five airplanes and seven merchant vessels participated in the two-day search for survivors. The *Athenian Venture* had a crew of 24, and the wives of 5 crew members were also on board. Initially it appeared that one of the lifeboats was missing from the vessel, but later it was found that all the lifeboats had burned. No survivors were ever found, and all 29 people were presumed dead.

References:

- 8/9/91 & 8/28/91 Letters from Daniel Owen at ITOPF
- Genwest Systems, Inc. communications with ITOPF representatives.
- MMS Worldwide Tanker Spill Database
- OSIR Newsletter 5/02/88
- OSIR Newsletter 2/21/91
- OSIR Oil Spills, International Summary & Review, 1986-1988
- Tanker Advisory Center, Inc. 1991 Guide for the Selection of Tankers. T.A.C. Inc. 1991.

Name of Spill: *Bahia Paraiso*

Date of Spill (mmddyy): 01/28/89

Location of Spill: Palmer Station, Antarctica

Latitude: 64 47 S

Longitude: 064 06 W

Oil Product: Diesel fuel arctic (DFA)

Oil Type: Type 2

Barrels: 3,774

Source of Spill: Non-Tank Vessel.

Resources at Risk: Krill, amphipods, limpets, gulls, terns, Giant Petrels, penguins, skua chicks, macroalgae, clams, fish, seals.

Dispersants: No

Bioremediation: No

In-situ Burning: No

Other Special Interest: Research conducted, habitat impact due to oil, wildlife impacts.

Shoreline Types Impacted: Exposed rocky shores.

Keywords: Evaporation, skimmer, U.S. Navy Superintendent of Salvage (NAVSUPSALV), boom, salvage.

Incident Summary:

On January 28, 1989, the *Bahia Paraiso*, with a cargo of diesel fuel arctic, jet fuel (JP-1), gasoline, and compressed gas cylinders, ran aground off Delaca Island, 2 miles from the US scientific base at Palmer Station, Antarctica. A 30 foot gash was torn in the ship's hull. The vessel spilled 3,772 barrels of diesel fuel arctic and cylinders of propane and compressed gas into the water. Heavy losses occurred among krill and limpets. Scientists on-scene recorded a 50% mortality rate among penguin chicks, but no significant losses among adult penguins. The spill also resulted in the death of skua chicks. While these chicks were not directly oiled, adult skuas were observed abandoning their nests, allowing other skuas (which are cannibalistic) to prey on their young. Thousand of other polar seabirds were reported killed. Several oiled seals were spotted.

Behavior of Oil:

By February 4, 1989, most of the islands within a 2 mile radius of the spill site had been contaminated with oil. Ultimately, the oil formed a slick with a 10 mile radius. The heaviest contamination occurred in Biscoe Bay and Arthur Harbor. Intertidal areas on Norse Point, Laggard Island, Limitrophe Island, Cormorant Island, and Jacobs Island were affected. Three weeks after the spill, Biscoe Bay had been cleaned through the processes of evaporation and wave action. By April, the leakage from the *Bahia Paraiso* was greatly reduced, and only those areas close to the wreck (Bonaparte Point, DeLaca Island, and Janus Island) showed oil. A National Science Foundation (NSF) scientist estimated the initial leaking rate to be approximately 71 barrels a day.

Countermeasures and Mitigation:

The Argentinean ship *Capitan Alacazar* arrived February 5 from Chile's Antarctic Institute to assess the damage to the environment from the oil spill. The *Capitan Alacazar* took water samples and surveyed the area for oiled wildlife. The *Polar Duke* arrived at Palmer Station on February 6 carrying equipment and various U.S. agency (NSF, NOAA, USCG, U.S. Navy Supervisor of Salvage (NAVSUPSALV) personnel and Chilean contract divers.

The Chilean Coast Guard Tender *Yelcho* arrived February 6 and deployed a boom which didn't hold. By February 7 there were skimmers working on scene and divers were inspecting the hull. Chilean divers sealed two holes in the vessel's fuel tanks. By February 8, 30% of the oil had been recovered.

Emulsification and weathering of the oil hindered recovery efforts. Salvage engineers from Argentina began offloading fuel from the *Bahia Paraiso* on February 11. The Argentinean vessel *Bahia San Blas* was on scene as of February 12 with recovery equipment. A NAVSUPSALV skimmer was used to transfer fuel from the *Bahia Paraiso* to the *Bahia San Blas*.

Other Special Interest Issues:

New Zealand conservationists reported that oil would take 100 times longer to degrade in Antarctica's environment than in more temperate environments. They also reported that oil could be incorporated into the ice, depriving sunlight and nutrients to organisms beneath the ice. They emphasized the need to complete cleanup before winter ice formed.

Intertidal areas were most directly affected by the spill, however samples collected over a six-week period showed DFA contamination in tissues from birds, limpets, macroalgae, clams, bottom feeding fish, and in water, and sediment. Most of the DFA evaporated with the remainder dispersed by currents. Possibly because of chronic releases from the ship, there was evidence of persistence of contamination a year after the spill. Intertidal limpet populations showed only partial recovery. Populations were reduced by 50 per cent directly after the spill.

As of March 12, 1992, the vessel remained on her starboard side in 50 feet of water, still containing about 1500 barrels of diesel fuel. Occasional oil slicks were observed around the vessel. U.S. cost estimates of pumping remaining oil from the ship are \$3,000,000 and \$60,000,000 to completely salvage the vessel. Because it is only possible to work in the Antarctic summer, the salvage process would take about 3 years. The governments of The Netherlands and Argentina have signed a memorandum of understanding to remove the remaining oil from the ship.

References:

- Culver, M., Fraser, W., Kennicutt II, M., Stockton, W., and Sweet, S. The Fate of Diesel Fuel Spilled by the *Bahia Paraiso* in Arthur Harbor, Antarctica, Oil Spill Conference Proceedings, 1991, pp.493-500.
- Lloyds List, Monday, March 30, 1992.
- Unpublished USCG report

Name of Spill: *Bayou Lafousche /Barge PC 2901*
Date of Spill (mmddyy): 03/09/73
Location of Spill: Upper Galveston Bay, Houston Ship Channel, Texas
Latitude: 29 38 N
Longitude: 094 58 W
Oil Product: Louisiana crude, Bunker C
Oil Type: Type 3, Type 4
Barrels: 10,000
Source of Spill: Tank Barge
Resources at Risk: Waterfowl, diving coastal birds, shrimp, oysters, marinas.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Adverse weather conditions.
Shoreline Types Impacted: Saltwater marshes, exposed tidal flats, sand/gravel beaches.
Keywords: Collision, boom, vacuum truck, vacalls, oil mop machines, hand mops, sawdust, Sorbent C, sorbent pillows, skimmer, filter fence, adverse weather conditions, contingency plan.

Incident Summary:

On March 9, 1973 at approximately 1326, the tank vessel *T/V Mayo Lykes* collided with the *Bayou Lafousche/Barge PC 2901*. The bow of the *T/V Mayo Lykes*, penetrated the port bow of the barge at a 45-60 degree angle, and almost cut the barge in two. Only the starboard outer skin of the barge held the vessel together.

A large quantity of the 23,000 barrels of Louisiana crude oil and Bunker C spilled into the water upon impact. Later estimates reported 10,000 barrels of pollutant spilled into the water. Part of the spilled amount was released in the collision while the remainder leaked from the damaged tanks over the next several days.

Weather conditions at the time of the accident were extremely adverse. Extensive fog, winds of 30-35 knots with 40 knot gusts, and seas of 3-4 feet hampered early containment attempts. Since the owner and operator of the damaged barge denied any responsibility in cleaning up the oil, U.S. Coast Guard (USCG) personnel began cleanup operations using the Oil Spill Contingency Fund. Brine Service Company was the primary cleanup contractor from March 12 until March 18 when Clean Channel Industries became the principal contractor, focusing on beach cleanup. After March 12, the USCG took on a strictly supervisory and monitoring role while contract personnel performed the actual cleanup.

Two days after the spill, the local Audubon Society, with USCG assistance, collected and cleaned approximately 400 oil soaked Eared Grebes. The 320 surviving birds were released in an unpolluted area selected by the Texas Parks and Wildlife Department. The Texas Department of Health, EPA Region 6, and Texas A&M University conducted ecological and pollutant studies in the affected area. Preliminary results showed little long-term adverse effect to the environment. Active cleanup continued until April 6 when the case officially closed, however cleaning on Atkinson and Bulkhead Reef Islands to the east of the Houston Ship Channel continued until the week of April 9.

Behavior of Oil:

Louisiana crude oil is a medium to light oil with a range of API gravity values between 34.5 and 37. Bunker C fuel oil is a heavy product with an API gravity that ranges from 7 to 14. Prevailing southeasterly winds rapidly carried oil to beaches in upper Galveston Bay. A large quantity of oil drifted into the Houston Yacht Club in the hours following the incident. Overflight observers on March 10 reported heavy concentrations of oil impacting the beaches and water north to Morgan Point, east to the Houston Ship Channel, south to Clear Creek Channel, and west to the shores of upper Galveston Bay. Overall, approximately seven miles of tidal flats and beach were contaminated as a result of the incident. High tides accompanied by strong south winds caused oil on the shore or trapped in bayous to contaminate areas above the normal tidal zone. Increased impacts of this type were observed at Little Cedar Bayou, Sylvan Beach, Bayside Terrace, and Shoreside Acres.

Considerable quantities of free floating oil were observed off Red Bluff Point on a March 14 overflight. Oil pockets were spotted on the beach line from Todville to Morgan Point as well. On March 16, high winds caused the water level in Galveston Bay to drop 3-4 feet in 3-4 hours. As a result, much of the oil remaining in Bayport Channel and Little Cedar Bayou escaped into the bay and was pushed south by the wind.

By March 16, weathering had made the oil very heavy and viscous, making recovery difficult. Strong northerly winds on March 17 blew much of the oil to the south back down the bay, contaminating many of the beaches south of Red Bluff Point. When the case closed on April 6, some contamination remained on Atkinson and Bulkhead Reef Islands to the east of the Houston Ship Channel. Approximately 519,302 gallons of liquid pollutant, and 400 cubic yards of solid oil soaked debris, were collected in the 28-day cleanup response.

Countermeasures and Mitigation:

A total of 9600 feet of five different types of spill *boom* was deployed during this response. Vessel wake over one foot and/or currents over 1 knot from transiting ships reduced effectiveness of *round boom*. The round boom was found to be bulky, difficult to tow, and relatively ineffective given the weather conditions. *Skirted boom (Uniroyal 18")* was better suited for the job and could be used in seas to four feet. A Boston Whaler easily towed 300 foot lengths of this boom. Cedar Bayou was boomed off on March 10 to prevent oil from escaping back into Galveston Bay. Multiple booms were required at the Houston Yacht Club to prevent more oil from entering the harbor. *Vacuum trucks* were used to removed approximately 190,000 gallons of trapped oil from the Houston Yacht Club Marina.

Vacalls, which are small vacuum recovery devices, were a primary recovery device at this incident. A total of 18 vacalls ranging in capacity from 50 barrels to 130 barrels were on-scene at any one time. Vacalls were used almost exclusively at Little Cedar Bayou due to availability of access roads leading down to the areas of collected oil.

Mopping techniques were used principally for beach cleanup between Surf Oaks and Sylvan Beach. Two types of *oil mop machines*, the *Mark II-9D-PT* and the *Mark II-4E*, provided excellent recovery of heavy concentrations of oil. First, a continuous mop reclaimed oil from the water. The machine then squeezed oil from the mop into a collection pan where it was then pumped into a vacuum truck. *Hand mops*, or *Jambeaux Mops*, were used to remove sheen and small quantities of oil from the water in hard to reach areas such as among marsh grass and on tidal flats. The oiled mops were then passed through a mop wringer and the oil collected in 55 gallon drums.

Sawdust, *Sorbent C*, and *sorbent pillows* removed residual oil from the water. Sorbents were used mainly along low lying areas and beach heads.

Two *skimmers* retrieved oil in open water areas. The 30' by 110' barge-style *Exxon skimmer* performed well during this response due to its ability to operate in various weather conditions. However, the skimmer could not operate in water shallower than 5 feet. The *Clean Channel Industry skimmer*, *M/V Lady Alice*, with a total capacity of 170 gallons, needed to be unloaded every ten minutes since it was recovering 1,000 gallons per hour. This skimmer was primarily used to recover oil in the immediate vicinity of the barge as well as pump out barge tanks that were still leaking.

On March 26, a *filter fence* was constructed in Little Cedar Bayou to collect oil as it drifted in and out of the bayou. This fence consisted of chain link fence attached to four sets of aluminum fence posts across the bayou. Three sorbent pillows were placed in the resulting compartments to catch residual product as it was pushed through the fence.

Other Special Interest Issues:

Adverse weather prevailed throughout the response. *Dense fog, high winds,* and *high seas* resulted in poor visibility and vessel maneuverability. Strong winds and high tides moved the oil above normal tide lines in some beach areas. *Periodic rain* made the ground too soft at times to move heavy equipment, such as vacuum trucks, in and out of oil pick-up areas. On March 16, high winds caused the water level in Galveston Bay to drop 3-4 feet in 3-4 hours which severely affected the movement of the oil. Adverse weather also created safety hazards to responders.

References:

- USCG Federal On-Scene Coordinator's Report

Name of Spill: *Betelgeuse*
Date of Spill (mmddyy): 01/08/79
Location of Spill: Bantry Bay, Ireland
Latitude: 50 40 N
Longitude: 012 04 W
Oil Product: Mixed Arabian Crude Oil
Oil Type: Type 3
Barrels: 14,720
Source of Spill: Tank Vessel
Resources at Risk: Mussels, diving coastal birds, waterfowl, scallops, clams, commercial fisheries.
Dispersants: Yes
Bioremediation: No
In-situ Burning: No
Other Special Interest: Closure of commercial fishing areas, closure of recreational fishing areas, wildlife impacts, complex salvage operations.
Shoreline Types Impacted: Rocky shores.
Keywords: Manual removal, suction operations, containment boom, skimmer, BP 1100WD, explosion, fire, sinking, sub-surface oil, salvage, lightering.

Incident Summary:

In the early afternoon of January 8, 1979, the tanker *Betelgeuse* exploded at the offshore pier of the Gulf Oil Terminal at Whiddy Island in Bantry Bay, Ireland. The tanker broke in two and settled in 130 feet of water with 300,000 barrels of oil remaining onboard. The fire burned throughout the day. During the night the fire was extinguished and the stern section sank completely. Approximately 14,720 barrels of oil leaked from the vessel, 3,680 barrels of which impacted the shoreline.

Behavior of Oil:

The Mixed Arabian crude oil contained in the vessel had an API gravity of about 36.5, and a viscosity of 23 centistokes at 20 degrees C. The oil that was released from the tanker burned as it leaked until the fire went out late on January 8. On January 9, a slick began to form, and oil impacted the east shore of Bantry Bay and Reenydonagan Point on Whiddy Island. Inspections revealed that 37 barrels of oil per hour was leaking from the wreck. Oil leaked at this rate for a week. On January 12, the oil impacted the north and south shores of Bantry Bay. By the next day the oil had spread as far west as Castle Townbere on the north shore of the bay, and League Point on the south shore. Bear Island was also impacted.

Countermeasures and Mitigation:

Cleanup operations were organized by the Cork County Council. Operations included the manual removal of oil, and the spreading of hay to absorb oil on the shoreline. Suction operations were also conducted on the shore. Booms contained the oil leaking from the tanker. Contained oil was treated with dispersants applied from planes, and was skimmed with a Gulf Oil Company Bay skimmer. Boom was placed across the mouth of the Glengariff Harbor to prevent oil from entering it.

Undamaged tanks were lightered using floating hoses running to the shore facilities.

Other Special Interest Issues:

Dispersant application began on January 10 off Reenydonagan Point. BP 1100WD was applied from Gulf tugs. The Cork County Council and the Department of Fisheries stopped the shoreline applications that morning when it was discovered that the dispersant were being applied incorrectly. Aerial spraying was done thereafter, and only on slicks of fresh oil. The aircraft used was a modified Piper Pawnee crop sprayer capable of 5 spraying sorties per hour due to the nearby location of a suitable landing strip. Application rates were generally around 2 to 3 gallons of BP 1100WD concentrate per acre. A total of about 35 tonnes (approximately 260 barrels) of dispersant was used in a 12-day period. The use of dispersants is believed to have successfully protected the shoreline.

The slick prevented fishing in some areas and nets were fouled by sunken oil. The harvesting of shellfish, including periwinkles, scallops and clams was also affected as some catches were rejected by buyers. Oiled seabirds were also found.

The bow section of the *Betelgeuse* was salvaged by L. Smit and Company. On February 21, it was towed to sea by the tug *Smit-Lloyd 107*. The bow was sunk at 50 40 N, 012 04 W on February 23. Salvage operations continued throughout the year. Part of the midsection was raised on August 30. The rest of the midsection was raised in December. The stern was raised on July 1, 1980. The midsection and the stern were scrapped.

References:

- Cross, et al. 1979. The Initial Pollution of Shores in Bantry Bay, Ireland, by Oil from the Tanker *Betelgeuse*. Marine Pollution Bulletin, Vol. 10, pp. 104-107. Pergamon Press Ltd. 1979.
- Genwest Systems, Inc. communications with ITOPF representatives.
- Hooke, N. Modern Shipping Disasters 1963-1987. Lloyds of London Press. 1987.
- MMS Worldwide Tanker Spill Database
- National Research Council. 1989. Using Oil Spill Dispersants on the Sea. National Academy Press, Washington, D.C. p.321.
- Nichols, J.A. and Parker, H. 1985. Dispersants: Comparison of Laboratory Tests & Field Trials with Practical Experience at Spills., Oil Spill Conference Proceedings 1985. pp. 421-427.
- Nichols, J.A. and White, I.C. 1979. Aerial Application of Dispersants in Bantry Bay following the *Betelgeuse* Incident. Marine Pollution Bulletin, Vol. 10. pp. 193-197. Pergamon Press, Ltd. 1979.
- OSIR Oil Spills, International Summary & Review, 1978-1981
- Tanker Advisory Center, Inc. 1991 Guide for the Selection of Tankers. T.A.C. Inc. 1991.

Name of Spill: *Borag*
Date of Spill (mmddyy): 02/05/77
Location of Spill: Keelung, Taiwan
Latitude: 25 12 N
Longitude: 121 44 E
Oil Product: No. 4 Fuel Oil
Oil Type: Type 3
Barrels: 213,690
Source of Spill: Tank Vessel
Resources at Risk: Power plant water intakes, industrial water intakes, commercial fisheries, abalone, crabs, lobsters, crawfish, Japanese Eels, seaweed, anchovies, mackerel, tuna, recreational beaches, fish aquaculture stocks.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Wildlife impacts.
Shoreline Types Impacted: Sand/gravel beaches, exposed rocky shores.
Keywords: International Tanker Owners Pollution Federation (ITOPF), skimmer, boom, sinking, adverse weather conditions, oil mop machines, manual removal.

Incident Summary:

On February 7, the *Borag* grounded on Hsin Lai Reef off Keelung, Taiwan while en-route to the Chinese Petroleum Corporation (CPC) oil terminal at Shen Ao. On February 15, heavy weather caused the vessel to break up and sink, releasing more oil. Approximately 213,690 barrels of No. 4 Fuel Oil leaked from the vessel.

Behavior of Oil:

No. 4 fuel oil has an API gravity of about 16.5. Most of the oil drifted out to sea, but 60 miles of sand beaches and rocky shores along Taiwan's northern coast were oiled. A large amount of oil entered the Keelung Harbor, causing welding to be prohibited for fear of igniting a fire. Oil was trapped in a number of small fishing village harbors and accumulated to a thickness of up to four inches.

Countermeasures and Mitigation:

International Tanker Owners Pollution Federation Ltd. (ITOPF) personnel arrived on scene on February 13 to assist in oil spill response operations. The CPC had a *Rheinwerft skimmer* which was deployed at the Sheh Ho power station. The *oil there proved to be too viscous to be recovered* by the skimmer. The power stations at Sheh Ho and Shen Ao had some Bennett boom which was effectively used. There were limited stocks of *dispersant available*, but the necessary vessels and helicopters to make effective application of them were not available. Little additional oil spill response equipment was available in Taiwan.

ITOPF personnel ordered two nine-inch Oil Mops, but they arrived three days later than expected. *The Oil Mops*, used in conjunction with tugs towing booms to collect oil, *proved very effective in recovering oil*. Two four-inch Oil Mops arrived from Singapore and recovered oil effectively, but broke down almost immediately. On February 14, approximately 2000 feet of Bennett boom were deployed with good results around power plant water intakes and across a number of harbor entrances. Booms were supplied to local fishermen to protect their boats, but many boats were oiled as the majority of the fisherman failed to use the booms as instructed.

Further cleanup measures included offering five dollars reward for every barrel of recovered oil. *Locals collected oil manually using buckets* which were brought to the CPC oil terminal for disposal.

Other Special Interest Issues:

The anchovies fishery was disrupted as fishermen were reluctant to risk oiling their nets. Scarcity of abalone and tuna, and mortalities among crabs, lobsters, and crawfish were claimed by fishermen. Seaweed was claimed to be in short supply by those who collect it. Japanese eels are collected along the coast near Keelung for stocking of aquaculture sites, and for export to Japan. Fishermen claimed mortalities among the eels, and interference with their harvesting.

References:

- Genwest Systems, Inc. communications with ITOPF representatives.
- Hooke, N. Modern Shipping Disasters 1963-1987. Lloyds of London Press. 1987. pp. 75-76.
- Spill Technology Newsletter, March-April 1977. pp. 58-59.

Name of Spill: *Bouchard #65*
Date of Spill (mmddyy): 1/28/77
Location of Spill: Buzzards Bay, Massachusetts coast
Latitude: 41 37 N
Longitude: 070 41 W
Oil Product: Number 2 home heating oil
Oil Type: Type 2
Barrels: 1,932
Source of Spill: Tank Barge
Resources at Risk: Lobsters, molluscs
Dispersants: No
Bioremediation: No
In-situ Burning: Yes
Other Special Interest: Unusual or experimental cleanup techniques, adverse weather conditions, logistical or operational problems.
Shoreline Types Impacted:
Keywords: Atlantic Strike Team (AST), skimmer, vacuum truck, adverse weather conditions, suction operations, lightering.

Incident Summary:

On the afternoon of January 28, 1977, the barge *Bouchard #65* grounded in a water depth of 17 feet in the ice covered waters of Buzzards Bay, Massachusetts. The barge was carrying 76,191 barrels of Number 2 heating oil. The grounding ruptured four of the seven tanks, initially spilling 95 barrels of oil. The *Bouchard #65* was towed 4 miles north to Wings Neck where it was grounded intentionally to prevent its sinking and the further release of oil. On the morning of January 29, the *Bouchard #85* arrived to begin offloading the oil remaining on the barge. Later that day the Atlantic Strike Team (AST) arrived to assist in the offloading operations. The *Bouchard #65* continued to leak oil during the tow to Wings Neck and during lightering operations. The barge was then towed to the Massachusetts Maritime Academy on January 29 where offloading operations continued. On January 30, the barge was finally towed to Boston, Massachusetts where the remaining cargo was offloaded.

Behavior of Oil:

Number 2 fuel oil is a medium weight material with a minimum API gravity of 30. The *Bouchard* #65 spilled 1,932 barrels of No. 2 fuel oil. Approximately 95 barrels of oil were spilled at the site of the initial grounding, and more oil leaked as the vessel was towed and grounded at Wings Neck. Approximately 30% of the spilled oil collected into pools of almost pure product at the interstices formed by rafting ice. The ice also effectively contained the oil and prevented it from impacting the shoreline. Some *long range transport of oil did occur* as oiled ice drifted and melted in areas far from the spill site. The oil was originally contained in a .04-square mile area. After the ice broke up, the slick covered 7.5 square miles. Approximately 285 barrels of oil were lost to weathering.

Countermeasures and Mitigation:

Cleanup operations began on January 29. Cannon Engineering, Coastal Services, Inc., and Jetline Services, Inc. were contracted to clean up the spill. Vacuum trucks were used to remove the concentrations of almost pure product from the interstices formed by rafting ice. About 18 percent of the spilled oil (about 357 barrels) was recovered, mostly by this method. Initially, hoses were run from the trucks on the shore to the pools of oil. As the ice began to move and break up, a vacuum truck onboard a tug was used to continue the recovery operations. Five inches of snow fell on February 5 and mixed with the oil, resulting in an oily slush which was much harder to recover with vacuum trucks.

A Navy Marco skimmer and a Lockheed Arctic Boat were deployed. The Marco skimmer did not recover any significant amounts of oil. Ice wedged in the Lockheed skimmer's intake area, preventing the oil from contacting the recovery disk. Skimmers worked well only in large areas of ice-free water. Because of this they were almost totally useless in the Buzzards Bay operations. Strong currents also hindered skimmer operations.

Some oiled ice was removed using cranes and trucks. The crane used an "I" beam to rake oiled ice towards the shore. Once collected at the water's edge, front end loaders loaded the oiled ice into trucks for removal to landfills. This method removed very little oil, and caused the shoreline to become oiled.

On January 31, the *USCG ignited the oil slick* at the site of the initial grounding, burning approximately 48 barrels of oil.

Movement and breakup of the ice, snowfall, and the extreme cold hindered the response, which continued until February 25.

Other Special Interest Issues:

Problems arose with ice clogging the hoses to the vacuum trucks. Sections of hose had to be repeatedly removed and thawed. It was noted that when air was prevented from entering the hoses, clogging problems were reduced.

References:

- Baxter, et al. 1978. The Bouchard #65 Oil Spill, January 1977, Appendices. U.S. Department of Commerce, NOAA. 6 appendices.
- Deslauriers, et al. 1977. The Physical and Chemical Behavior of the Bouchard #65 Oil Spill in the Ice Covered Waters of Buzzards Bay. Prepared for U.S. Department of Commerce, NOAA. 77 pp.
- Gundlach, et al. 1978. Some Guidelines for Oil-Spill Control in Coastal Environments, Based on Field Studies of Four Oil Spills. Chemical Dispersants for the Control of Oil Spills, ASTM STP 659. L.T. McCarthy, Jr., G.P. Lindblom, and H.F. Walter, Eds. American Society for Testing and Materials. pp. 98-118.
- MMS Worldwide Tanker Spill Database
- NOAA. 1977. Bouchard #65 Oil Spill in Ice Covered Waters of Buzzards Bay.

Name of Spill: *Brazilian Marina*
Date of Spill (mmddyy): 01/09/78
Location of Spill: Sao Sebastiao, Sao Paulo, Brazil
Latitude: 23 48 S
Longitude: 045 43 W
Oil Product: Kuwait Crude Oil
Oil Type: Type 3
Barrels: 73,600
Source of Spill: Tank Vessel
Resources at Risk: Fine sand beaches, exposed tidal flats.
Dispersants: Yes
Bioremediation: No
In-situ Burning: No
Other Special Interest: Effects to tourism, effects to recreation areas.
Shoreline Types Impacted: Fine sand beaches, exposed tidal flats.
Keywords: Pacific Strike Team (PST), Gulf Strike Team (GST), manual removal, BRAS-X-plus, disposal.

Incident Summary:

On the morning of January 9, 1978, the tanker *Brazilian Marina* grounded in the Sao Sebastiao Channel, Sao Paulo, Brazil. Tanks ruptured and spilled approximately 73,600 barrels of Kuwait crude oil. Approximately 18,000 barrels of the spilled product impacted the shoreline. Personnel from the United States Coast Guard (USCG) and the United States Environmental Protection Agency (EPA) responded to the spill at the request of Brazilian Authorities. Most of the organized shoreline cleanup was focused on the recreational beaches. Cleanup personnel initially used dispersants to combat the oil on some beaches, but this proved to have negative ecological effects and was stopped.

Behavior of Oil:

The oil was carried to the northeast by the currents. Approximately 18,400 barrels of the spilled oil impacted the shoreline, and the remainder drifted out to sea. Beaches and coastal embayments were oiled in the States of Sao Paulo and Rio de Janeiro. Six of the beaches of Ubatuba, Sao Paulo were heavily impacted. Overflights on January 22, showed a 200 square mile slick composed of sheen and some emulsified oil which remained off Ponta Juatinga for a week, and then began to dissipate.

Countermeasures and Mitigation:

Officials from Sao Paulo contacted the US EPA. The EPA and the USCG sent personnel to help in the spill response. The USCG personnel concentrated on directing cleanup operations while the EPA personnel concentrated on sampling and assessing the ecological damage.

Recovery operations at sea involved the use of a *Hydrovac*, but most of the oil had dissipated by the time it was deployed.

Shoreline cleanup operations concentrated on recreational beaches. Beaches of little economical importance or ecological sensitivity were left alone. Oiled sand was removed both *manually* and by *front end loaders*. *Hay* was spread on some beaches to absorb the oil, and was subsequently gathered and *buried* on the beach above the high water mark.

Other Special Interest Issues:

Petrobras (the national oil company of Brazil) applied dispersants to four of the Ubatuba beaches. Approximately 5,500 gallons of undiluted BRAS-X-plus were applied to 13 miles of beaches. The application of dispersants had great cosmetic effects on the beaches. The visible oil was removed and the beach could then be used recreationally. However, it was not an effective cleanup technique, as the dispersants caused the oil to spread down into the sand, thereby complicating the manual removal of the oil, and causing it to persist longer in the environment. EPA tests proved *BRAS-X-plus to be toxic even in small amounts* to selected marine microfauna. Companhia de Tecnologia de Saneamento Ambiental (CETESB) ordered that the application be stopped once its effects became evident.

The beaches at Ubatuba are a tourist attraction, however, the incident caused little damage to the tourist trade. Vacationers used the beaches while beach cleanup was in progress. At some beaches, operations were delayed as the cleanup had to be conducted around sunbathers.

References:

- Dewling, R.T. and Silva, C. 1979. Impact of Dispersant use During the Brazilian Marina Incident. Oil Spill Conference Proceedings, 1979, pp. 269-276.
- Genwest Systems, Inc. communications with ITOPF representatives.
- MMS Worldwide Tanker Spill Database

Name of Spill: Buckeye Pipeline
Date of Spill (mmddyy): 03/30/90
Location of Spill: Knapp Run, Pennsylvania
Latitude: 40 40 N
Longitude: 079 40 W
Oil Product: TransMix (Gasoline, Kerosene, No. 2 Fuel Oil)
Oil Type: Type 2
Barrels: 1,790
Source of Spill: Pipeline
Resources at Risk: Marshes, drinking water intakes, industrial water intakes, mussels, waterfowl, wading birds, nesting beaches
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Human health and safety concerns.
Shoreline Types Impacted: Vegetated riverbanks.
Keywords: Siphon dam, filter fence, skimmer, sorbent booms, collection boom, vacuum truck, Atlantic Strike Team (AST), Regional Response Team.

Incident Summary:

At 2300 on March 30, 1990, a landslide caused a pipeline break and the subsequent release of approximately 1,790 barrels of TransMix into the Allegheny River at Knapp Run, located two miles above Freeport, Pennsylvania. The spill was reported to the Marine Safety Office (MSO) Pittsburgh on the morning of March 31. The spill posed a potential threat to local drinking water intakes as well as sensitive habitats in back channels, shoals, embayment areas, and tributaries.

The Regional Response Team was activated from April 1-4. The USCG Atlantic Strike Team (AST) monitored cleanup and provided site safety. The AST and MSO personnel formed two shoreline cleanup monitoring teams on April 2. The Pennsylvania Emergency Management Agency (PEMA) promulgated information on potential alternative water supplies. The Ohio River Sanitation and Navigation Commission (ORSANCO) collected water samples and used fluorometry to analyze concentrations of the pollutant in the river. River velocities were used to estimate the arrival time of pollutant at several water intakes on the Ohio River. Several water intakes on the Allegheny River were closed from April 2-4. Increasing the flow of the Allegheny River to dilute the contaminant was considered and rejected. No significant wildlife impacts were reported.

Behavior of Oil:

By the morning of March 31, the oil had traveled down the Allegheny River from the incident site near river mile 32 to river mile 25. At 1800 EST on April 1, the leading edge of visible oil was reported to be at river mile 13.3 in the area of Lock and Dam #3. Several seeps were also observed along the stream in the incident area.

The leading edge was observed at river mile 5.0 at 1100 on April 2. A continuous rainbow sheen still emanated from Knapp Run. One of three settling ponds from an oil strip mining operation near Knapp Run contained a heavy accumulation of product.

Mid-day on April 3, fluoremetry analyses indicated that the leading edge was at about Ohio River mile 22. Only one cleanable containment site was left on the Allegheny River. A few main seepage sites were still leaking pollutant into the settling ponds at Knapp Run. By April 4, cleanup efforts were exclusively at Knapp Run.

Countermeasures and Mitigation:

Buckeye personnel installed a *siphon dam* and *filter fence* in the stream. A second siphon dam with a 8" culvert pipe was built above the original dam. At this second dam, *skimmers* and vacuum trucks operated intermittently.

Several *sorbent booms* and a *hay filter dam* were placed across the surface of the stream between the *second siphon dam* and the Allegheny River.

Collection boom was deployed in several places along the Allegheny River. Sorbent booms was placed at the mouth of the Knapp Run when the water in the river dropped.

A *suction hose* removed pollutant from the settling ponds to a *vacuum truck*. *Collection sumps* as well as a *drum* in the ground collected pollutant seepage before it entered the stream.

On the evening of April 10, heavy rains washed out some of the siphon dams and filter fences. Although the largest dam was still intact, water intakes on the Allegheny River were again closed as a precautionary measure.

Other Special Interest Issues:

Since the pollutant in the ground remained unweathered until seepage occurred, workers were in danger of being exposed to fresh sources of benzene and other toxic components. Therefore, *workers needed respiratory protection* for a variety of wind and weather conditions. The terrain of the spill area was steep, wooded, and slippery. Also, responders needed to traverse the stream, which made working conditions dangerous.

References:

- NOAA Hotline Reports

Name of Spill: *Burmah Agate*
Date of Spill (mmddyy): 11/01/79
Location of Spill: Galveston Bay, Texas
Latitude: 29 17.7 N
Longitude: 094 37.4 W
Oil Product: Nigerian Crude, blended crude (high naphtha content)
Oil Type: Type 4, Type 2
Barrels: 254,761
Source of Spill: Tank Vessel
Resources at Risk: Fine sand beaches, marshes.
Dispersants: No
Bioremediation: No
In-situ Burning: Yes
Other Special Interest: Logistical or operational problems, closure of shipping lanes or vehicle traffic routes, adverse weather conditions.
Shoreline Types Impacted: Fine sand beaches, marshes.
Keywords: Collision, explosion, fire, vacalls, vacuum truck, Open Water Oil Containment and Recovery System (OWOCRS), Open Water Oil Recovery System (OWORS), skimmers, U.S. Navy Superintendent of Salvage (NAVSUPSALV), Clean Water, lightering, salvage, Gulf Strike Team (GST), boom, manual removal.

Incident Summary:

On the morning of November 1, 1979, the *Burmah Agate* and the *Mimosa* collided at the entrance to Galveston Harbor. The *Mimosa* struck the *Burmah Agate* on its starboard side, tearing an 8 by 15 foot hole in the hull near Cargo Tank No. 5. An explosion occurred upon impact, and the leaking oil ignited. The USCG immediately dispatched the Coast Guard Cutter *Valiant* to begin search and rescue operations. By 1230 all 26 crew members of the *Mimosa* had been found, but only 6 of the *Burmah Agate's* 37 crew members were accounted for. The owners of the *Burmah Agate* assumed responsibility for the spill response. They contracted Clean Water, Inc. for cleanup operations, and Smit International Inc. to fight fires on the *Burmah Agate*, and to assist in salvage. The *Burmah Agate* burned until January 8, 1980 and was towed to Brownsville, Texas on February 1 for scrapping.

Behavior of Oil:

Booms and skimmers were deployed to protect beaches. Seasonal winds kept most of the oil offshore, however, heavy concentrations of oil washed ashore at Galveston and San Jose Island. Lighter concentrations of oil impacted Padre Island and the Bolivar Peninsula. Oil came ashore on November 5 at Galveston Jetties and East Beach, and cleanup began immediately. Oil impacted the Matagorda Peninsula on November 6. On November 9, six barrels of oil impacted 437 yards of marshes and sand beaches around Smith Point and five areas on Galveston Island. The Smith Point area was the only inland area impacted by oil. The marsh areas were not cleaned up because response efforts could have caused greater damage than the oiling. Boom was deployed in the San Luis Pass area and there was an attempt to deploy a Marco skimmer in that area. A crane from Galveston was necessary to deploy the skimmer.

By November 12, a slick composed of sheen and mousse in windrows extended 8.5 miles WSW of the tanker. Oil in the form of small tarballs impacted Padre Island near Mansfield Pass on November 13. Approximately eight barrels of oil came ashore at Padre Island where no cleanup was done. Heavy concentrations of oil impacted Galveston beaches on November 18. The heaviest impacts of oil occurred near Jamaica Beach November 19-21. On November 24, Jamaica Beach was cleaned with *Vacalls*. Streamers were observed near Bolivar Peninsula on November 27. Most of the oil burned in the ship or in the water near the ship, however by December 7, a 19 mile long slick extended to the SSW of the tanker.

Most of the oil spilled from the tanker was blended crude with the remainder the heavier Nigerian crude. Thirty-eight per cent of the oil carried by the *Burmah Agate* was recovered through lightering operations. Of the remaining oil, an estimated 1.7 per cent was picked up by skimmers, .5 per cent impacted beaches, 48 per cent burned, and 12 per cent dispersed offshore. Ultimately, 2,100 barrels impacted various beaches and marshes.

Countermeasures and Mitigation:

The G & H Towing Company tugs *The Judge*, *Carol Hayden*, and *R.C. Hayden* fought the fire under the direction of the Commanding Officer of the USCGC *Valiant* until Smit International, Inc. personnel arrived. The G & H tugs were not manned by trained firefighters, and they had a tendency to leave effective fire fighting positions when explosions occurred aboard the tanker. The G & H tugs continued under the direction of Smit International, Inc. personnel until better vessels were procured.

On November 2, the GST arrived with 612 feet of Open Water Oil Containment and Recovery System (OWOCRS) and two Air-Deliverable Anti-Pollution Transfer Systems (ADAPTS) . Western Marine provided boats for the deployment of the GST's equipment. The shipping lanes into Galveston were closed in both directions for a short time on the first day of the incident, and again on November 5 while the *Mimosa* was towed to Galveston. Subsequently, the outgoing lanes were opened.

GST personnel worked through the night and into the morning of November 3 to deploy a boom astern of the tanker. In the early evening of November 3, *nine firefighters from the Netherlands arrived with additional equipment*. Various problems occurred during the evening of November 3; kinks in the boom, no boom lights, and a boom line fouled the prop of a deployment vessel. The Dutch tug *Jacob Van Heemskerk* was on-scene in the morning of November 4, and began applying water to the *Burmah Agate*.

In the early morning of November 5, more explosions aboard the *Burmah Agate* opened several starboard and center tanks. The On-Scene Coordinator (OSC) and acting Captain of the Port (COTP) contacted the U.S. Navy Supervisor of Salvage (NAVSUPSALV) to bring in booms and skimmers with personnel to operate them.

On November 7, the *Linda Partain* arrived on-scene to fight fires along with the *Jacob Van Heemskerk* and the *Seaspan Raider*. Goodyear boom was deployed astern of the *Burmah Agate*. On November 8, only the *Linda Partain* remained alongside the tanker, applying water to the forward tanks to cool them. The other two tugs had moved away due to explosions. Vessels continued to deploy the Goodyear boom near the *Burmah Agate*. On November 10, 2,000 feet of Goodyear boom was deployed north of the *Burmah Agate* to protect the Galveston Channel and Bolivar Peninsula. Booming of the San Luis Pass area was completed with the deployment of 4,000 feet of boom. Oil entrainment was discovered under the booms astern of the tanker.

On November 11, a Marco Class V skimmer was deployed to back up the boom under which oil had entrained. The boom to the north of the tanker was damaged by a response vessel during the night of November 11, and was replaced. It was damaged again on November 12, and on November 16. Another portside tank exploded, and burning oil hit the booms and set them on fire. A Lockheed skimmer Open Water Oil Recovery System (OWORS) was deployed but one of its flotations was punctured, and was removed for repairs. On November 13, two OWOCRS were deployed. The boom caught fire again on November 14.

On November 17, the *Bering Sea*, with two Marco skimmers attached to outriggers, and the *Midnight Flash*, with the Lockheed skimmer attached to an outrigger, came on scene and began skimming operations.

By November 21, there were 400 people cleaning the beaches. Beach cleanup was done by *manual removal* of oiled sand, which was loaded into dump trucks by front-end loaders. Loaders removed too much sand from the beaches and they were replaced with vacuum trucks. Cleanup of beaches was complete by November 27.

On January 8, the fire was put out, and deployment of 4000 feet of Goodyear boom and OWOCRS began in anticipation of lightering efforts. There was a delay in offloading operations because the owners of the *Burmah Agate* were slow to award a contract. The lightering began on January 17 and continued until February 3. Approximately 160,000 barrels of crude oil were recovered by lightering operations.

Other Special Interest Issues:

On November 22, adverse weather prevented fire fighting and deployment of skimmers, and from November 28 to 29 bad weather prevented all cleanup operations.

On December 5, the OSC requested the Pilots Association to meet ships 4 miles farther out to sea than the *Burmah Agate*. as the OSC felt that ships were passing too close to the containment and recovery gear. On December 17 a foreign vessel anchored near the *Burmah Agate* and carried away the Goodyear booms as it dragged anchor. The boom was re-deployed the next day.

Through the duration of the response, four skimming barriers (OWOCRS) and one Lockheed skimmer (OWORS) were used. Heavy seas (typical of winter weather in the area) hindered booming and oil recovery efforts. Oil began to entrain under the OWOCRS when the current reached .75 knots, and once the current reached 1 knot the *OWOCRS were totally useless*. Furthermore, the OWOCRS were only useful in a stationary configuration, and could not be maneuvered effectively to follow a moving slick. *Problems also arose due to the constant replacement of vessels in the OWOCRS configuration*. Eleven vessels were rotated through deployment and maintenance of the OWOCRS. This rotation was caused by short-term contracting of vessels by the owners of the *Burmah Agate*. While problematic, the rotation of various types of vessels did illuminate the characteristics of a vessel best suited for OWOCRS deployment and maintenance. These characteristics were: seaworthiness (which the crew boats did not have due to their small size), large work area astern, maneuverability (twin-screw, bow-thruster equipped boats worked the best), onboard tank space, open stern close to the water, and adequate power. Of all the vessels used, a large offshore supply vessel worked the best. *Deployment of booms and skimmers around the burning tanker before the fire was extinguished resulted in the ignition and subsequent loss of 4000 feet of Goodyear boom and one OWOCRS*. The Marco Class V skimmer proved to be the most effective skimmer.

The Lockheed skimmer (OWORS) broke down and spare parts were not readily available. This made on-site repair of the OWORS impossible. Furthermore, the deployment of the OWORS in conjunction with the OWOCRS was difficult. *When attached to an outrigger on a vessel, the OWORS did have partial success in recovering oil*.

Staging areas for response vessels and storing areas for USCG and NAVSUPSALV equipment were difficult to find. The OSC finally rented a dock from the U.S. Army Corps of Engineers, however the OSC had to arrange for the docking of the Army dredge *Gerig* once it returned to port.

References:

- Kana, T., R. Pavia, E. Thompson. 1981. *Burmah Agate* - Chronology and Containment Operations, Oil Spill Conference Proceedings, 1981, pp.131-139.
- USCG On-Scene Coordinator's Final Report

Name of Spill: *Cabo Pilar*
Date of Spill (mmddyy): 10/08/87
Location of Spill: Punta Davis, Chile
Latitude: 53 00 S
Longitude: 074 00 W
Oil Product: ENAP crude oil
Oil Type: Type 2
Barrels: 40,900
Source of Spill: Tank Vessel
Resources at Risk: Crabs, kelp, submerged aquatic vegetation, sea lions.
Dispersants: Yes
Bioremediation: No
In-situ Burning: No
Other Special Interest: Wildlife impacts, research conducted, adverse weather conditions.
Shoreline Types Impacted: Exposed rocky shores.
Keywords: Manual removal, disposal, Corexit 9527, Slickgone LTE.

Incident Summary:

On October 8, 1987, the *Cabo Pilar* grounded in the Magellan Strait, while en-route from Clarendia-Gregorio to San Vicente, Chile. Approximately 40,900 barrels of ENAP crude oil was spilled into the Strait off Punta Davis. Dispersants and manual methods were used in cleanup operations. The *Cabo Pilar* was refloated on November 3, and continued on its voyage.

Behavior of Oil:

ENAP crude oil has an API gravity of 39.0, and a pour point of 6 degrees C. A 1 mile wide by 10 mile long oil slick formed along Paso Largo. *Approximately 31 miles of coastline were oiled*, with the Abra Canal suffering the worst impacts.

Countermeasures and Mitigation:

Cleanup operations, conducted by the owners of the vessel, began on December 12. Oil was *cleaned up manually, using shovels and buckets*. The collected oiled debris was *buried* on the beaches. Cleanup was hampered by the generally bad weather in the area.

On October 14, Wifsmuller Salvage was hired to offload the oil remaining on the *Cabo Pilar*. Operations began on November 1, and the oil was transferred to the *Torn Rask*.

Dispersant application began the day after the spill. Two different dispersants were applied using *Warren Spring Laboratories (WSL) MAXI and WSL MINI equipment*. *Corexit 9527* (582 gallons) and *Slickgone LTE* (3380 gallons) were used. Approximately 3774 barrels of oil were treated with dispersants. *It could not be discerned whether the oil dissipated due to the high energy waters in the area or due to the dispersants.* Studies done by the University of Magallanes three months after the spill showed that the dispersants did not affect the marine resources in the area.

Other Special Interest Issues:

Impacts to king crabs and seabirds were minimal. Seaweed was severely affected. The south coast of Abra Canal, the most heavily impacted area, was found to be totally devoid of intertidal organisms in studies conducted by the University of Magallanes three months after the spill.

References:

- Pizarro, F. 1989. The Cabo Pilar Grounding and Oil Spill, Oil Spill Conference Proceedings, 1989, pp.61-64.
- The Physical Persistence of Spilled Oil: An Analysis of Oil Spills Previous to Exxon Valdez. 1990. A report prepared by Advanced Technology, Inc. for NOAA HAZMAT.

Name of Spill: *Chevron Hawaii*
Date of Spill (mmddyy): 09/01/79
Location of Spill: Deer Park, Texas
Latitude: 29 42 N
Longitude: 095 08 W
Oil Product: Santa Maria Crude oil, Catalytic cracker feedstock
Oil Type: Type 3
Barrels: 20,000
Source of Spill: Tank Vessel
Resources at Risk: Shrimp, waterfowl, oysters, abundant beds, State Park.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Effects to personal property.
Shoreline Types Impacted: Marshes, developed upland, swamps, piers, flats.
Keywords: Vacalls, vacuum truck, oil mop machines, skimmers, manual removal, water-washing, absorbents, salvage, Gulf Strike Team (GST), Atlantic Strike Team (AST), explosion, fire, sinking, adverse weather conditions, boom, reoiling.

Incident Summary:

On September 1, 1979, at 1412, the *SS Chevron Hawaii* exploded, burned, and sank while discharging cargo at the Deer Park Shell Oil Company terminal on the south side of the Houston ship channel. The cargo of catalytic cracker feedstock and Santa Maria crude oil spilled into the sea as the fire burned for ten hours. Lightning apparently ignited accumulated cargo vapors on the deck of the vessel. None of the cargo tanks had been gas-freed. The explosion was so powerful that a 5 foot by 7 foot hull fragment from the burning vessel penetrated the roof of a Shell Oil Company petroleum product shore tank located 600 feet inland from the vessel. The contents of that shore tank, approximately 26,000 barrels of ethyl alcohol, ignited and burned as well. As the fire spread into a nearby barge slip, four barges that were discharging cargo caught fire. Three of these barges exploded and sank. No significant amount of pollution came from any of these four barges. Weather during the incident was warm and windy with heavy downpours and lightning. The maximum reported wind gust for the day was 33 knots, at 1300.

The fireboat *M/V Captain F. L. Farnsworth*, which had been moored 2.5 nautical miles from the terminal, was on-scene by 1430. Four boats and 14 Coast Guard personnel assisted in fire fighting and lifesaving operations. Two Coast Guard pollution team investigators from the Houston Port Safety Station were already on their way to the Shell terminal when the accident occurred. They led the rescue of the burning vessel's boatswain from the forecandle. Representatives from both the USCG Pacific and Gulf Strike Teams (PST and AST) monitored all phases of the cleanup. Eighteen different cleanup companies were involved in the cleanup operations. Since the spill occurred over a holiday weekend, it was difficult to recruit companies with equipment specifically needed for this spill.

One crew member and two radar repairmen aboard the *SS Chevron Hawaii* were killed and 13 people were injured. Even though six tugs were available within the barge slip, no attempt was made by the Shell Oil Company dockman or the tugboat operators to move any adjacent barges into the channel where they might have been safe from the fire. Also, the dockman left the scene without activating the emergency cut-off switch. This would have assured that any adjacent barges' cargo openings were properly secured. *Damages to the vessel, barges and facility exceeded \$27,000,000.*

Behavior of Oil:

Oil leaking from the ship impacted the entire area from the ship to Diamond Shamrock for the first 6 days following the explosion. An oily rain fell on nearby houses, cars and swimming pools as a result of the explosion. The spreading of the oil on the water limited the usefulness of the Coast Guard boats in firefighting by clogging the boat engines and fire pump intakes. The oil continued to flow into the main stream in the middle of the channel. Much of the oil and oily debris collected in a bend in the channel near the incident area. Boom assisted this natural containment in slowing the spread of oil.

A large amount of the oil collected at the oil tanking area on the north side of the channel. Due to wind and water movement, a substantial amount of oil accumulated at Jacinto Port. The western shore of Old River was heavily oiled, from two miles upstream down to the entrance of the river, while the flatlands on the east side were only slightly oiled. A small amount of oil entered the Peggy Lake area. Bayous, foreshores, and an area of marsh grass at San Jacinto State Park were lightly oiled. The sides of the battleship *Texas* in an adjacent small creek were oiled as well.

Large quantities of oil entered Paktank Equity ITC, a major grain loading and general industrial facility. The oil was then covered with wheat dust, which made it very difficult to clean up. Oil collected at the Diamond Shamrock outfall when the wind was in the east. The Boggy Bayou refinery outfall was also heavily oiled.

Between September 18 and 20, torrential rainfall caused considerable washing of the whole spill area. An unknown amount of oil moved down the channel and out to sea. Many cleaned areas were re-impacted with oil and oily debris following the rains. Oil also moved into marsh grass areas that had not previously been affected.

Countermeasures and Mitigation:

The *M/V Captain F. L. Farnsworth* fought fires around the vessel with firefighting foam. This vessel stayed on-scene until September 2.

Containment boom was available but was not required for offloading operations and had not been deployed prior to the incident. The stored boom was engulfed by the flames. Boom was opened and closed at Diamond Shamrock to collect oil when the wind was in the east. Boom helped collect a major part of the oil east of the ship for direct pumping into the dirty ballast system on shore. Opening and closing of boom for vessel traffic along with some tugs running right over the boom often released the contained oil.

Two kinds of vacuum trucks were employed during the cleanup. *Vacalls*, vacuum trucks with very powerful air pumps, were the most efficient at sucking up the oil. The other *vacuum trucks* were used primarily to transport oil that had been collected by the vacalls. *Oil mop recovery devices* were used in the oil tanking area.

Small floating *skimmers* were only useful in sheltered areas since the wakes of passing ships made operations in the main channel too dangerous. A large Exxon skimmer, directed by a helicopter overhead, collected oil from the south end of the channel up towards the Lynchburg Ferry.

Many *manual methods* were used during the cleanup operations. *Water washing techniques* and *absorbent materials* were used to clean the bayous in San Jacinto State Park. Water washing was used to clean jetties as well. The cleanup inspection team decided not to conduct cleanup operations on some environmentally sensitive areas such as the east bank of Old River.

Commercial diving and *salvage operations* began in October. Damaged portions of the hull and cargo tanks of the *Chevron Hawaii* were cut into sections for removal by barges.

Other Special Interest Issues:

After this incident, the National Transportation Safety Board (NTSB) recommended that more attention be given to the proper maintenance and inspection of cargo tank closures.

References:

- Genwest Systems, Inc. communications with ITOPF representatives.
- Golob's 1978-1989 US Spill Report
- Hooke, N. Modern Shipping Disasters 1963-1987. Lloyds of London Press. 1987.
- MMS Worldwide Tanker Spill Database
- National Transportation Safety Board. 1980. Marine Accident Report: Explosion and Fire on Board the SS CHEVRON HAWAII with Damages to Barges and to the Deer Park Shell Oil Company Terminal, Houston Ship Channel, September 1, 1979.
- Oil Spill Intelligence Report. Oil Spills, International Summary & Review, 1978-1981
- Tanker Advisory Center, Inc. 1991 Guide for the Selection of Tankers. T.A.C. Inc. 1991.
- World Information Systems. Tanker Losses in U.S. Waters: 1978-1990. World Information Systems. 1991.

Name of Spill: Chevron Main Pass Block 41
Date of Spill (mmddyy): 2/10/70
Location of Spill: 11 miles east of the Mississippi River delta, Louisiana
Latitude: 29 23 N
Longitude: 088 59 W
Oil Product: crude oil
Oil Type: Type 3
Barrels: 65,000
Source of Spill: Platform
Resources at Risk: shrimp, crabs, fish
Dispersants: Yes
Bioremediation: No
In-situ Burning: No
Other Special Interest: Research conducted.
Shoreline Types Impacted: Sand beaches.
Keywords: Boom, skimmer, evaporation, fire, Shell Oil Herder, relief well, straw.

Incident Summary:

The Chevron Main Pass Block 41C platform caught fire on February 10, 1970 and burned until March 10. Oil and gas flowed from the well until March 31. Chevron hired Red Adair of Houston to put out the fire.

Behavior of Oil:

By February 13, a rainbow sheen extended a half of a mile from the platform towards the northeast. By February 27, a 10-yard wide oil slick extended 10 miles to the southwest from the spill area. On March 4, oil impact estimated at 20 barrels was found on Breton Island. Chevron began cleaning with straw and skimmers that day. Collection of patches of oil extending 14 miles to the northwest began that day with sweeping boom. By March 5, Breton Island was cleaned of oil by rain and wave action. By March 12, a heavy slick was extending in a 5 mile radius from the platform, and moderate slicks were extending 15 miles to the southeast and the northwest. It was estimated that of the oil spilled, 25-30% evaporated, 10-20% was recovered, and 1% dissolved. Later studies estimated one per cent remained in the sediments surrounding the platform. The remaining oil emulsified, dispersed or biodegraded.

Countermeasures and Mitigation:

Chevron immediately began cooling the platform with water and collecting booms in anticipation of the release of oil which would occur once the fire was out. About 2,000 barrels of two chemical dispersants mixed with water were sprayed on the platform during the spill to keep the platform water-wet for personnel safety and to prevent the structure from melting if the oil and gas reignited. No attempt was made to treat the entire slick with dispersants. Red Adair came on scene on February 26. The drilling barges *Penrod* and *Mr. Arthur* began drilling relief wells on March 4, while the drilling barge *S-66* was enroute to the scene. Construction of a platform from which firefighting and well capping operations could be carried out was completed by March 5. Louisiana State University Coastal Studies Institute came on scene on March 6 and began current studies which were completed on March 21.

The fire was put out on March 10 and the resulting release of oil was estimated at 1000 barrels per day. By the day the fire was put out, containment barges had been deployed around the platform and skimmers were on scene to catch any oil which slipped beyond the barge booms. While the Coast Guard estimated that 85%-90% of the oil was contained behind the ring of booms around the platform, on March 11, an oil slick was observed to extend 7 miles to the north of the spill area. Five skimmer boats, one skimmer barge, and six Swedish skimmers were in operation as of March 11. Well capping efforts began that day, and continued through March 30 although they were occasionally interrupted by bad weather. It was noted on March 12 that *where a J M boom was failing to hold oil, a Navy boom was working effectively.*

Oil Herder #3, an experimental herder from Shell Chemical Company, was authorized on March 10 for use on the spill under the direction of the Federal Water Pollution Control Administration (FWPCA) personnel on scene. Later experiments with herder *were inconclusive*, and further tests were scheduled for the March 13. Two days later, permission to use one barrel of the herder per day was given by the United States Geological Survey (USGS). As of March 11, relief wells 1 and 2 continued to be drilled, and a third relief well had begun to be drilled. On March 13, the work platform for Red Adair's personnel was completed. A bird survey of the Chandeleur Island chain was conducted, and as of the March 13, there were no injuries to wildlife reported.

One thousand seven hundred sixty barrels of oil emulsion were recovered by the March 13 with 957 barrels of it recovered by the skimmer barge alone. On March 14 an additional 2,367 barrels of oil emulsion were recovered. On March 15, marsh protection operations were readied and 2,800 barrels of emulsion were picked up. A March 16 survey of beaches revealed no oil impacts.

Heavy weather on the March 17 caused extensive damage to the barges and booms. Most booms were damaged beyond the capability to repair them on scene and needed to be replaced. Barge redeployment did not begin again

until March 21. Skimmers and skimmer boats were unable to operate in the high seas generated by the weather. Oil impacted Breton Island again on March 17, and the cleanup personnel there spread straw as an absorbent.

Skimmer operations collected 2,102 barrels on March 19 for a total of 15,613 barrels of emulsion recovered since skimming operations began on March 9. Navy booms were deployed on March 23. All wells were capped by March 30.

Other Special Interest Issues:

Little damage appeared to have occurred to beaches, wildlife, or marine life during the course of the spill from untreated or dispersed oil. Two hundred thirty three benthic samples were collected in which over 550 benthic organism species were identified. The number of species and the number of individuals were lower in some samples near the platform, but seasonal variations, sediment types, Mississippi River discharges, and other environmental parameters may have been the cause of the reduced numbers. Extensive trawl samples showed no changes in shrimp life cycles and blue crab and fish populations were comparable to numbers from prior surveys. No correlation was found between number of species, number of individuals and hydrocarbon content of sediment samples collected within a ten mile radius of the platform.

References:

- Groover, R., Jones, G., McAuliffe, C., Pickle, W., Smalley, A., Welsh, W., 1975. Chevron Main Pass Block 41 Oil Spill: Chemical and Biological Investigations. Oil Spill Conference Proceedings, 1975, pp.555-566.
- National Research Council. 1989. Using Oil Spill Dispersants on the Sea. National Academy Press, Washington, D.C. pp.318-319.
- U.S. Coast Guard POLREP file.

Name of Spill: *Christos Bitas*
Date of Spill (mmddyy): 10/12/78
Location of Spill: Irish Sea, South Wales
Latitude: 51 43 N
Longitude: 005 40 W
Oil Product: Heavy Iranian Crude Oil
Oil Type: Type 3
Barrels: 21,990
Source of Spill: Tank Vessel
Resources at Risk: Wildlife refuge, oyster beds, seabirds, seals, bird sanctuaries.
Dispersants: Yes
Bioremediation: No
In-situ Burning: No
Other Special Interest: Adverse weather conditions, wildlife impacts, logistical or operational problems.
Shoreline Types Impacted: Sand/gravel beaches, exposed rocky shores.
Keywords: International Tanker Owners Pollution Federation Ltd. (ITOPF), skimmer, lightering, containment boom, manual removal, high-pressure washing, suction operations, BP 1100X, sinking.

Incident Summary:

At 1634 on October 12, 1978, the *Christos Bitas* ran aground on rocks approximately 10 miles off Milford Haven, Pembrokeshire, Wales. After about half of its tanks ruptured, the tanker floated free of the rocks. The master of the vessel requested assistance from Her Majesty's Coast Guard in controlling the spilled oil, and the *Christos Bitas* continued for Belfast, its planned destination. The tanker was stopped at 52 25 N, 005 40 W at the request of British Petroleum Tanker Company, the owner of the cargo, and H. M. Coast Guard.

The tanker was carrying 257,250 barrels of heavy Iranian crude oil. Approximately 21,990 barrels spilled into the Irish Sea. Nearly all the cargo was offloaded to other vessels, and the *Christos Bitas* was scuttled in the North Atlantic on October 31, 1978. Oil impacted some beaches in South Wales, as well as on Skomer Island, and the North Devon coast. *Dispersants were used throughout the spill response*, which lasted until November 13.

Behavior of Oil:

Heavy Iranian crude oil has an API gravity of 31.0, and a pour point of -5 degrees F. The resulting oil slick off Milford Haven was approximately 6 miles wide by 10 miles long. Dispersants were used almost immediately, and the combination of the chemicals and the gale-force winds and high seas helped to break up the oil. Oil impacted beaches in St. Bride's Bay, on Skomer Island and from 30 to 40 miles of the North Devon coastline. Approximately 335 tons of emulsified oil and oiled debris were recovered in shoreline cleanup operations.

Countermeasures and Mitigation:

On the morning of October 13 the vessel was listing heavily and H. M. Coast Guard began rescue operations. A British Petroleum representative arrived on the tanker to assess the situation. He suggested that three tankers would receive oil in offloading operations. Inspections revealed that the vessel was in danger of sinking, and it was decided at a meeting of the owner's agents and representatives from the Greek Embassy, International Tanker Owner's Pollution Federation Ltd. (ITOPF), the Protection and Indemnity (P & I) Club, the Ministry of Defense, the Ministry of Agriculture, Fisheries and Food, and the Nature Conservancy Council, that the ship should be lightered. In the early afternoon of October 13, British Petroleum contracted United Towing Ltd. to conduct salvage operations. The United Towing tug *Guardsman* began towing the *Christos Bitas* to a position that would minimize damage if a further release of oil occurred. Skimmers and booms were brought to BP's Ocean Terminal at Angle Bay (the incident command post) in preparation for the possible release of oil. The *Taurus* arrived on scene on October 18 with two *Oceanpacks*, one *Seaskimmer*, one *Midi-skimmer*, and two *Komara* units.

Pump specialists arrived with *high-capacity Mohn pumps* from Rotterdam in the late afternoon of October 14 for offloading operations. Oil transfer to the *Esso York* began late that night. By early the next day, the *Esso York* had received 9,849 barrels of oil. The *Christos Bitas* was now low in the water with the starboard side of its deck submerged. Air was pumped into intact tanks to make the vessel more buoyant. These efforts failed because the tanks were not airtight. On October 15, the *Esso York* departed with 13,965 barrels of oil onboard, and the *British Dragoon* took its place in the offloading operations. The *British Dragoon* had airtight fittings that were installed on the *Christos Bitas*. Efforts to maintain air pressure in the tanks were then successful, and the tanker's attitude in the water improved. By the early morning of October 17, the *British Dragoon* had received 88,935 barrels of oil, and the *Christos Bitas* was upright in the water. Later that morning the vessels had to separate due to a storm. By October 20, 191,100 barrels of oil had been removed and lightering operations ended two days later. Approximately 7,350 barrels of oil remained on the vessel.

Diving operations were conducted on October 22 and 23 to determine if the *Christos Bitas* was fit for towing into the Atlantic Ocean to the chosen sinking site. The diving operations suggested that the vessel was not as damaged as had been originally thought. Upon receipt of this information, the owners of the *Christos Bitas* requested time to consider repairing the tanker. Ultimately, it was decided to tow the vessel to the Atlantic Ocean and sink it. A site 580 miles from the Irish coast was chosen for the sinking, and towing to that point began on October 26. Weather worsened on October 30, and by the next day the tug was having difficulty making headway. The *Christos Bitas* was in an area considered to be a suitable alternative for a sinking location. The vessel was sunk at 51 22 N, 018 13 W in the afternoon of October 31, approximately 300 miles west of Fastnet Rocks, Ireland. A 400 foot by 600 foot slick formed at the sinking site, but periodic overflights of the area through November 13 showed that the slick had dissipated.

Overflights of the coastline of Wales began immediately. On October 17, it was discovered that several beaches in St. Bride's Bay were oiled. Two of these were the *ecologically sensitive areas of Martin's Haven on the mainland and North Haven on the Skomer Island*, which is a nature reserve. An estimated 440 barrels of oil impacted Martin's Haven. British Petroleum supplied a Cooper Pegler beach spray unit and backpack sprayers for beach application of dispersants. *Dispersants had little effect on the mousse, and dispersant operations were abandoned* in favor of manual removal of the oil and oiled debris. Approximately 35 tons of oil and oiled debris were removed from the beach using tractors, buckets and shovels. Final cleanup of the Martin's Haven beaches involved *high-pressure water washing* and application of dispersants. Cleanup operations lasted four days ending on October 20.

Approximately 2,570 barrels of water-in-oil emulsion impacted the beaches of North Haven, Skomer Island, which was inhabited by 40 seals. Manual removal of the mousse began on October 19. A boom was successfully used on the beach to keep the mousse concentrated in one area. By the fourth day of cleanup the mousse began to wash into the water, and three NOFI booms were deployed to contain the oil. A Komara Miniskimmer (a disc skimmer) was used to recover oil from the containment booms, but was ineffective due to the high viscosity of the oil. A Bantry Bay skimmer (a belt skimmer) was used with little success to recover the oil. *The oil would not adhere to the skimmer's belt, and it was observed that the oil had been treated with dispersants and might not have had adequate surface tension to adhere to the belt.* A mono-suction pump on the Bantry Bay skimmer recovered oil efficiently, and with a second pump brought on scene, the oil in the three booms was recovered by October 26. By October 28, due to difficulty in contracting labor, manual removal operations stopped. Approximately 250 tons of oil and oiled debris were manually removed, and 368 barrels of emulsion were recovered from the containment booms.

Oil impacted the North Devon coastline in small amounts on October 25. The oil impacts were deemed too small to warrant a response.

Other Special Interest Issues:

Of the forty seals on Skomer Island, three died from oiling. Approximately 1,520 oiled birds were found, of these 1035 were dead and the rest were sent for cleaning. Of the total oiled, 1030 were Guillemots and 346 were Razor-bills. The rest included Gannets, Puffins, Manx Shearwaters, Common Scoters, Black Guillemots, Herring Gulls, Greater Black-backed Gulls, and Red-throated Divers.

By the evening of October 14, thirty-seven vessels with dispersant spraying capabilities were on scene. *Approximately 655 barrels of concentrated dispersant and 952 barrels of standard dispersant were applied to a 6 mile by 10 mile slick.* Applications were effective from both vessels and aircraft. British Petroleum boats applied 116 barrels of the dispersant *BP 1100X*.

References:

- "Christos Bitas—The Success Story," Safety at Sea, February 1979, No. 119, pp. 24-27
- Genwest Systems, Inc. communications with ITOPF representatives.
- Hooke, N. Modern Shipping Disasters 1963-1987. Lloyds of London Press. 1987.
- Oil Spill Intelligence Report, October 20 1978, Vol. I, No. 3
- Oil Spill Intelligence Report, October 27, 1978, Vol. I, No. 4
- Oil Spill Intelligence Report, November 3, 1978, Vol. I, No. 5

Name of Spill: *Concho*
Date of Spill (mmddyy): 01/19/81
Location of Spill: Kill Van Kull, New York
Latitude: 40 35 N
Longitude: 074 01 W
Oil Product: No. 6 Fuel Oil
Oil Type: Type 4
Barrels: 18,149
Source of Spill: Tank Vessel
Resources at Risk: Waterfowl, fish, marshes.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Wildlife impacts, adverse weather conditions, volunteer response and organization.
Shoreline Types Impacted: Sand/gravel beaches.
Keywords: Atlantic Strike Team (AST), self-propelled skimmer, boom, Air-Deliverable Anti-Pollution Transfer System (ADAPTS), volunteers.

Incident Summary:

On the afternoon of January 19, 1981, the tank vessel *Concho* grounded in the eastern end of Kill Van Kull, off the northeastern tip of Staten Island. The bottom port side of the ship suffered damage. As the vessel continued down the Narrows towards New York Lower Bay, crewmen noted that it was listing to port. The vessel was deliberately grounded in Gravesend Bay off Brooklyn to prevent its sinking. The *Concho* was carrying 190,476 barrels of No. 6 Fuel Oil. Approximately 2,381 barrels of oil were spilled into the water.

Behavior of Oil:

No. 6 fuel oil is a heavy product with an API gravity that ranges from 7 to 14. Seventy-five per cent of New York Upper Harbor was covered with sheen. The sheen extended from the Hudson River near the World's Trade Center to Gravesend Bay in lower Brooklyn. Shoreline in Gravesend Bay was oiled. Some oil washed up on New Jersey and New York beaches, but most of the oil moved out to sea.

Countermeasures and Mitigation:

The United States Coast Guard (USCG) was on scene on January 19. Sabine Towing and Transport Company, the owners of the *Concho*, hired Ocean Salvors Company as cleanup contractor. On January 20, Atlantic Strike Team (AST) and Ocean Salvors personnel arrived on-scene and began offloading and diving operations. By January 21, a boom was in place around the vessel, skimming operations were underway, and 35,714 barrels of oil had been offloaded into a barge provided by Exxon. Lightering operations were performed with Air-Deliverable Anti-Pollution Transfer System (ADAPTS) pumps until the No. 6 oil became too viscous for them. Lightering continued using Framo and Thune-Eureka cold pumping systems, and was completed on January 25 when the vessel was light enough to float off the mudflat where it had been grounded.

Oil was recovered with JBF Dynamic Incline Plane (DIP) 3001 and 3003 self-propelled skimmers from Clean Harbors Cooperative. Booms were deployed in marsh areas in Bayonne by Clean Ventures personnel. The *Concho* was moved to Bayonne, New Jersey for temporary repairs and then sailed to Jacksonville, Florida for further repairs.

The Environmental Protection Agency (EPA) and the United States Fish and Wildlife Service (USFWS) monitored the environmental impacts of the spill.

Other Special Interest Issues:

The USFWS organized volunteers to rescue oiled birds. Rescue efforts were hampered by ice in the water, but 60 oiled birds, primarily ducks, were found. USFWS estimated that 500 birds had been oiled.

Ice in the water hindered containment, recovery, and lightering operations.

References:

- Genwest Systems, Inc. communications with ITOPF representatives.
- NTSB. 1981. Marine Accident Report - Grounding of the U.S. Tankship S.S. CONCHO, Constable Hook Reach of Kill Van Kull, Upper New York Harbor, January 19, 1981.
- Tanker Advisory Center, Inc. 1991 Guide for the Selection of Tankers. T.A.C. Inc. 1991.

Name of Spill: *Corinthos*

Date of Spill (mmddyy): 01/31/75

Location of Spill: Delaware River, Marcus Hook, Pennsylvania

Latitude: 39 49 N

Longitude: 075 25 W

Oil Product: Algerian crude oil

Oil Type: Type 2

Barrels: 266,000

Source of Spill: Tank Vessel

Resources at Risk: Waterfowl.

Dispersants: No

Bioremediation: No

In-situ Burning: No

Other Special Interest: Wildlife impacts, wildlife rehabilitation.

Shoreline Types Impacted: Exposed seawalls, developed uplands, piers, rip rap.

Keywords: Manual removal, collision, boom, Atlantic Strike Team (AST), fire, explosion, sinking, Regional Response Team, salvage.

Incident Summary:

At approximately 0030, on January 31, 1975, *Corinthos* was rammed as the *Edgar M. Queeny* maneuvered away from its dock. The *Corinthos* was in the process of offloading 315,000 barrels of Algerian crude oil at the British Petroleum terminal at Marcus Hook, Pennsylvania. The resulting explosion and fire reportedly shot flames 400-500 feet up into the air. The *Corinthos'* hull split and sank, while continuing to smolder until February 6. The *Edgar M. Queeny* was carrying *phenol, vinyl acetate, and paraffin* at the time of the incident. Approximately 2,000 barrels of paraffin were released as a result of the impact. Twenty six of the forty-four people aboard the *Corinthos* lost their lives as a result of the collision, explosion, and fire. Although the *Edgar M. Queeny* also caught fire, no fatalities were reported on that vessel.

Coast Guard personnel monitored the fire and pollution, controlled traffic and patrolled the security zone during the response. Pollution contractors were on scene within seventy-seven minutes of notification. Response personnel began booming creeks and wildlife areas immediately. Oiled waterfowl were taken to a cleaning facility at a New Jersey Armory. The Regional Response Team (RRT) was activated from January 31 through February 5. Coast Guard personnel from Marine Safety Office Philadelphia and the Atlantic Strike Team (AST) responded to the spill. Other response agencies included the Philadelphia City Fire Department, the U.S. Army, and the U.S. Navy. During 1976, the two sections of the sunken *Corinthos* were raised and towed to Camden, New Jersey to be scrapped.

Behavior of Oil:

Algerian crude oil has an API gravity of 44 to 45.5, and a viscosity of 2.2 centistokes. Burning crude oil covered a 10 mile stretch of the Delaware River following the incident. Heavy, asphalt-like residue adhered to the shorelines along the river.

On February 6, a boarding party reported large amounts of burnt oil residue on the stern deck plates. Two to three inches of oil on water were reported in a survey of accessible spaces and hatches on the *Corinthos*.

Countermeasures and Mitigation:

Asphalt-like residue on the shoreline of the Delaware River was *manually removed* with shovels.

Booms were placed at the entrances of Carby, Old Man's, and Raccoon Creeks. *Floating boom* deployed around the vessel created a security zone. Within seventy-seven minutes of notification cleanup personnel began deploying *directional boom* at Elinsboro Point, New Jersey in an effort to trap free-floating oil.

Since phenol, gasoline, and vinyl acetate monomer were involved in the fire, *explosion meter readings* and *oxygen levels* were monitored to assure a safe working atmosphere for responders.

Other Special Interest Issues:

During this time of year, about 4,000 birds use the area of the Delaware River where the incident occurred. A cleaning facility at the New Jersey Armory had treated 370 oiled birds as of February 10.

References:

- 8/9/91 & 8/28/91 Letters from Daniel Owen at ITOPF
- Hooke, N. Modern Shipping Disasters 1963-1987. Lloyds of London Press. 1987.
- MMS Worldwide Tanker Spill Database
- Tanker Advisory Center, Inc. 1991 Guide for the Selection of Tankers. T.A.C. Inc. 1991.
- USCG Case Summary

Name of Spill: E-24

Date of Spill (mmddyy): 11/22/85

Location of Spill: Block Island Sound, Fishers Island, New York

Latitude: 41 13.9 N

Longitude: 072 01.3 W

Oil Product: No. 6 Fuel Oil, Diesel Fuel

Oil Type: Type 4, Type 2

Barrels: 71

Source of Spill: Tank Barge

Resources at Risk: Bird nesting beaches, bird migration stopover areas, bird wintering concentration areas, diving coastal birds, waterfowl, bird migratory routes, exposed tidal flats, sheltered tidal flats, marshes.

Dispersants: No

Bioremediation: No

In-situ Burning: No

Other Special Interest: Complex salvage operations.

Shoreline Types Impacted: Exposed tidal flats, sheltered tidal flats, marshes.

Keywords: U.S. Navy Superintendent of Salvage (NAVSUPSALV), sinking, skimmers, boom, contingency plan, adverse weather conditions, salvage.

Incident Summary:

On November 22, 1985, at 1345, the tug *Norseman*, with the Tank Barge *E-24* in tow, reported that the barge was taking on water. The barge was loaded with 20,000 barrels of Number 6 Fuel Oil. Fifteen minutes later, the *E-24* was standing almost vertically with about 20 feet of the barge visible above the surface of the water. At the time of the incident, there was heavy rain, 5-6 foot seas, and winds from the east at 25 knots. The incident took place in an area known as "The Race," the passage between the Long Island Sound and the Atlantic Ocean, which typically has severe rip tides and rough, unpredictable seas. On November 23 at 2250 the barge sank in a keel-up position in 185 feet of water. Approximately *15-24 barrels of No. 6 fuel oil* was forced from compartment vents, and as much as *47 barrels of diesel fuel* was lost from the pump room. The cargo compartments were not damaged during the sinking.

Oil from the barge formed a slick measuring 0.5 miles long by 500 yards wide as observed on November 23. Cleanup of the Long Island shoreline began on November 24 and was completed by December 5. Approximately 1000 gallons of oily debris were recovered. Later releases of oil occurred during the salvage operations, but skimming equipment was on station and recovered most of that lost oil immediately. An estimated 225 birds were affected by the spill, with 75 of these recovered dead.

Salvage of the barge without damaging the intact cargo compartments was the major concern. Due to heavy seas and limitations of equipment on scene, the exact position of the barge could not be determined and verified until December 19. On January 3, 1986, the USCG On-Scene Coordinator (OSC) federalized the case as the responsible party, Eklof Transportation Co., Inc. was unable to meet the deadlines imposed by the OSC for performing the hull survey and inspection.

Evaluation, planning, and mobilization for the salvage operations took place from January 3 to May 4, 1986. The salvage plan was developed by the United States Navy Supervisor of Salvage (NAVSUPSALV) at the request of the OSC. The OSC staff report was completed on March 3, and detailed three salvage options determined by the NAVSUPSALV. After much deliberation, the OSC determined that the barge should be raised with its cargo intact. Salvage operations took place from May 5 to May 30, 1986. Approximately 235 gallons of oil were lost during the entire operation, of which 185 were recovered. The barge was inspected and in tow by the evening of May 29, and was moored at Mariners Harbor, Staten Island, New York by 1900, May 30. The E-24 was completely offloaded by June 11, 1986, and the case was closed.

Behavior of Oil:

No. 6 fuel oil is a heavy product with an API gravity that ranges from 7 to 14. Marine diesel fuel is a medium weight product with an API gravity of 31.3. The slick position observed on November 23 agreed with the trajectory provided by the National Oceanic and Atmospheric Administration (NOAA) Scientific Support Coordinator (SSC). This oil impacted the Long Island coast on November 23. Eklof Transportation Co. contracted Marine Pollution Control, Inc. to clean up the oil as it came ashore. Floating oil could not be recovered because of the rough sea conditions. The oil made its first landfall on the Long Island shoreline at 2220 on November 23, shortly before the barge finally sank. Intermittent contamination occurred from Montauk Point to Fort Pond Bay.

Countermeasures and Mitigation:

Due to the small amount of oil actually spilled, cleanup operations were completed rapidly. Based upon spill trajectories provided by the NOAA SSC, the entrance to Lake Montauk was boomed with 36 inch Sea Curtain as a precautionary measure on November 23. Cleanup personnel, under the supervision of Captain of the Port (COTP), New York, began cleanup of the Long Island shoreline as the oil made landfall. Boom was removed from the Lake Montauk entrance on November 25. On November 26, a representative from the US Fish and Wildlife Service (USFWS) estimated that as many as 300 birds would be affected by the spill. On December 13, the East Hampton, New York Environmental Director reported 75 dead birds recovered. Cleanup operations were finished by December 5, 1985.

The barge location was pinpointed on December 19, 1985. Eklof planned to perform a hull survey using a remotely operated vehicle on January 2, 1986, but the ROV was unavailable. The OSC gave Eklof until January 3 to produce an alternate plan, which it was unable to do. At this time, the OSC federalized the incident. Initial diving operations were largely unsuccessful due to poor weather and high currents in the area. *A survey was performed from January 27-31 using a diving bell.* This revealed that there was little structural damage and that no oil was leaking from the vessel.

The salvage operation was planned for specific weather, tide, and current conditions, and was scheduled to take place before mid-June to ensure that the oil temperature would remain below its pour point. NOAA provided trajectory scenarios for a catastrophic release. This was felt to be only a remote possibility, due to the structural integrity of the barge and the viscous nature of the oil at water temperatures below its pour point.

The final salvage plan involved partially lifting the E-24, moving the barge to shallow water, rolling it into an upright position, restoring buoyancy to float it and towing it to a disposal site. *A comprehensive pollution contingency plan was developed. It included: the possibility of a major release of oil; open water and shoreline cleanup based on the predictions of the spill trajectory models; equipment availability and response times, which included equipment available from NAVSUPSALV as well as the notification of contractors before the commencement of the operation; cost projections, including the transport of SUPSALV equipment; and pre-positioning and deploying the available equipment.*

Salvage operations began on May 17, 1986. About one hundred gallons were lost during rollover operations on May 27. Fifty gallons of this were recovered and the remainder formed sheen and small globs of oil in the water. On May 28, the barge was lifted to the surface, during which 130 gallons were lost and recovered.

The location of the barge was in an area where pre-approval for the use of dispersants exists, however, the oil composition precluded effective

dispersant use in this case. The use of chemical thickeners was not considered necessary due to the high viscosity of the oil in the barge.

Other Special Interest Issues:

Various plans for the fate of the barge were considered. These included leaving the barge and remaining cargo on the bottom; removing the cargo and leaving the barge on the bottom; and removing the barge and its cargo intact. Encapsulating the barge in place was not considered possible due to the strength of the currents in the area. The first option was ruled out because it was felt that the barge would rust and deteriorate over a period of years (as long as 20-30), causing a series of chronic spills, many pollution responses, and long term damage to the wildlife resources in the area. Additionally, once this course of action was chosen, the decision was irreversible; after deterioration had begun, the option to raise the barge and cargo intact would no longer be available.

Removing the cargo and leaving the barge, would have involved hot tapping the oil from each of the twelve tanks. This was felt to be too costly and difficult due to the depth and current considerations, the high viscosity of the oil, and the diver-intensive nature of these operations. Considering the difficulty in performing the earlier dive survey, a hot tapping operation did not appear feasible.

Raising the barge with its cargo intact was considered to be the best option under the circumstances. While some spilling during the rollover and lifting operations would occur, this option provided a permanent solution with the least chance of long-term spill damage, massive catastrophic spilling, and risk to personnel. In choosing this alternative, the high initial costs of the salvage were weighed against the long range costs of continual monitoring, response and cleanup of an ongoing spill, as well as the long term ecological damage presented by a slow deterioration.

References:

- Hooke, N. Modern Shipping Disasters 1963-1987. Lloyds of London Press. 1987.
- MMS Worldwide Tanker Spill Database.
- NOAA Hotline reports.
- OSIR Oil Spills, International Summary & Review, 1982-1985
- USCG COTP New London. Final On-Scene Coordinator Report on the Sinking and Subsequent Raising of the T/B E-24, 22 NOV 1985 - 29 MAY 1986.

Name of Spill: Ekofisk Bravo oil field
Date of Spill (mmddyy): 04/22/77 - 04/30/77
Location of Spill: Norway, North Sea
Latitude: 56 34 N
Longitude: 003 12 E
Oil Product: Ekofisk crude oil
Oil Type: Type 3
Barrels: 202,381
Source of Spill: Platform
Resources at Risk: Commercial fisheries, alcids, petrels, fulmars.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Adverse weather conditions, logistical or operational problems.
Shoreline Types Impacted: None.

Keywords: Blowout, drift cards, evaporation, water washing.

Incident Summary:

On April 22, 1977, well B-14 on the Phillips Petroleum Company's "Bravo" production platform in the Norwegian Ekofisk field experienced an oil and natural gas blowout. This platform is 180 miles southwest of the Ekofisk oil field center in approximately 230 feet of water. The blowout resulted in the first major oil release in the North Sea. A red-brown mixture composed of oil and mud spurted up to 180 feet into the air above the offshore drilling rig. The "blowout preventer" had apparently been placed upside down on the wellhead during an earlier maintenance procedure. The 112 crew members on the platform were safely evacuated. The blowout resulted in a continuous discharge of crude oil through an open pipe 20 meters above the sea surface. At an estimated rate of 1,170 barrels per hour, *approximately 202,380 barrels of oil escaped* before the well was finally capped seven days later on April 30. Considerably less oil entered the water due to rapid evaporation. *As much as 30-40% of the escaping oil may have evaporated before of shortly after hitting the water.* A higher-than-average air temperature (75°F) and the formation of small oil droplets contributed to rapid evaporation rate.

The area of the platform was experiencing 4-6 foot seas and below-average sea surface temperatures at the time of the blowout.

Red Adair was contracted by Phillips to assist in capping the blowout. Although weather conditions and hazardous gas accumulations slowed capping efforts, the rig was capped on April 30. *The Norwegian State Pollution Control Board declared that no major ecological damage resulted from the spill.* Following an inspection tour on the day of the capping, two U.S. Coast Guard experts recommended against sending any oil-skimming equipment to Norway. Weather and wave action during the following days were predicted to eliminate any visible slick.

Behavior of Oil:

Ekofisk crude oil has an API gravity of 35.7, and a pour point of -5 degrees C. By April 25, the slick was reportedly 15 miles long by 5 miles wide. Rough seas and wave action later this day broke the slick into two sections, the first being 14 miles long by 3.5 miles wide and the second 5 miles long by 0.5 miles wide. The oil moved primarily in an easterly direction from the time of the blowout until April 28.

Observations made on April 28 through May 1 described the previously thick oil slicks to be broken into windrows interspersed with blue sheen. The windrows extended out from the platform for approximately 20 miles until turning into specks of emulsion 1.5 inches in diameter. Oil reportedly spread out a maximum of 45 miles long by 30 miles wide around the platform area, characterized as patches of emulsion in large areas of light blue sheen. On May 2, maximum concentrations of oil in the water column were found 6 miles from the rig. Oil was found down to depths of 4 yards.

By May 3, the oil had drifted northward from Ekofisk about 120 km. A shift in the wind direction moved the oil southward, back towards Ekofisk, on May 12. Drift cards released at the time of the blowout were found along the northern coast of The Netherlands, indicating that in June the remaining oil drifted in a south-southeasterly direction. No shorelines were oiled.

Countermeasures and Mitigation:

As a fire prevention method, *water* was pumped on the platform by a Phillips company utility and fire fighting vessel.

Personnel from Red Adair, Phillips, and Moran International finally succeeding in stopping the geyser of oil on April 30.

From April 6 to April 28, approximately 2,000 plastic-wrapped *drift cards* were released from a nearby platform. Three satellite monitored drift buoys were also released in cooperation with the Norwegian Meteorological Institute and Christian Michelsens Institute.

Other Special Interest Issues:

Although rough seas and strong winds delayed capping attempts, the wave action helped break up much of the oil, preventing it from reaching any shoreline. Boom would have been ineffective in the rough seas that are characteristic of the North Sea.

The presence of dangerous gas concentrations forced an evacuation of the platform on April 25. Winds had previously kept the gas from accumulating around the platform.

References:

- 1991 World Almanac
- Fischer, D.W. ed. 1982. Managing Technological Accidents: Two Blowouts in the North Sea. International Institute for Applied Systems Analysis Proceedings Series. 234 pp.
- Review of Oil Spill Occurrences and Impacts, Exxon Production Research Company, 1989.

Name of Spill: *Eleni V*
Date of Spill (mmddyy): 05/06/78
Location of Spill: Norfolk, southeast coast of England
Latitude: 52 49 N
Longitude: 001 48 E
Oil Product: Heavy Fuel Oil
Oil Type: Type 4
Barrels: 52,500
Source of Spill: Tank Vessel
Resources at Risk: Molluscs, designated harvest sites, sand/gravel beaches, recreational beaches.
Dispersants: Yes
Bioremediation: No
In-situ Burning: Yes
Other Special Interest: Complex salvage operations, unusual or experimental cleanup techniques.
Shoreline Types Impacted: Sand/gravel beaches.
Keywords: BP 1100D, Dasic LTD, collision, explosion, fire, fingerprinting.

Incident Summary:

On the morning of May 6, 1978, the Greek tanker *Eleni V* was cut in two by the French vessel *Roseline* in foggy conditions off the southeast coast of England. The *Eleni V* was loaded with 117,280 barrels of Heavy Fuel Oil. The collision caused the release of approximately 52,500 barrels of oil.

The aft section was towed to Rotterdam by five Dutch tugs. The cargo remaining in the aft section was recovered by pumping it into storage tanks at Europort. The forward section of the vessel drifted away from the collision site. It went aground on May 8 on a sandbank near Lowestoft off the East Anglian coast with approximately 8000 barrels still on board. Attempts to salvage the forward part failed, and authorities decided to blow it up. The bow was towed to a position several miles offshore and blown up with two tons of explosives by Navy divers on May 30. Following the explosion, a large part of the remaining oil burned.

Behavior of Oil:

The heavy fuel oil had a viscosity of 5,000 centistokes at 20 degrees C. It formed a huge viscous slick that was brown to black in color. Oil washed ashore on the English and Dutch coasts. Oil on the shoreline formed pancakes between .25 and 12 inches in diameter. Oil was also reported as globules of thick mousse that appeared on the beaches. This became the worst case of marine pollution on the English coast since the *Torrey Canyon* spill, more than 11 years earlier.

Oil impacting on the Dutch coast was identified as similar to that of the *Eleni V* by gas chromatographic analysis. It was believed to have come from the bow section when it was blown up. Analysis of trajectory model outputs suggested that if the bow section had been blown up sooner, more of the oil

would have washed ashore in the estuaries of the Dutch coast, and along the British and Belgian coastlines. This was determined by the wind, weather and current conditions at the time of the demolition.

The spill affected shellfish areas and private and recreational beaches along the British and Dutch coasts. The holiday beaches in Norfolk and Suffolk were also impacted with pancakes and tarballs of the thick viscous oil. The pancakes formed a thick skin due to weathering.

Countermeasures and Mitigation:

This incident demonstrated the limits of dispersants on heavy viscous oils. When the slicks appeared following the collision, the immediate response was a major *chemical dispersant spraying* operation. It had been predicted early in the response that this particular type of oil would not readily disperse. Nonetheless, 22 vessels were used over a period of three weeks spraying chemicals on the oil. Nearly 240,000 gallons of *BP 1100D* and *Dasic LTD* were used. *The dispersant operation had virtually no effect on the oil*, and almost all of it went ashore anyway.

Other Special Interest Issues:

Dutch authorities used *gas chromatography* in an attempt to identify the oil that was impacting their shoreline. It was not positively identified as oil from the *Eleni V*, but it was determined to be similar. This research was combined with trajectory forecasting to determine the origin of the oil and the potential effects of the pollution if the bow section had been blown up earlier.

References:

- Genwest Systems, Inc. communications with ITOPF representatives.
- Hooke, N. Modern Shipping Disasters 1963-1987. Lloyds of London Press. 1987.
- National Research Council. 1989. Using Oil Spill Dispersants on the Sea. National Academy Press, Washington, D.C. pp. 319-320.
- Nichols, J.A. and Parker, H. 1985. Dispersants: Comparison of Laboratory Tests & Field Trials with Practical Experience at Spills, Oil Spill Conference Proceedings, 1985, pp. 421-427.

Name of Spill: *ESSO Puerto Rico*
Date of Spill (mmddyy): 09/03/88
Location of Spill: Mississippi River, Louisiana
Latitude: 29 55N
Longitude: 090 15W
Oil Product: Carbon black feedstock
Oil Type: Type 4
Barrels: 23,000
Source of Spill: Tank Vessel
Resources at Risk: Anadromous fish, bottom dwelling fish, water intakes
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Logistical or operational problems.
Shoreline Types Impacted: Vegetated riverbank.
Keywords: Sub-surface oil, fingerprinting, Atlantic Strike Team (AST), absorbent pads, suction operations.

Incident Summary:

At approximately midnight on September 3, 1988, the *ESSO Puerto Rico*, loaded with carbon black feedstock, departed EXXON Corporation's Baton Rouge facility bound for the Gulf of Mexico. Around 0800, the vessel apparently struck the anchor of a Lykes ship at the Kenner Bend Anchorage (river mile 114), opening the No. 1 starboard tank and releasing 23,000 barrels of carbon black feedstock. The bulk of the material was released over a period of 45 minutes. During this time, the vessel traveled about 10 miles down the river. At the time of the incident, river currents were less than one knot, wind was southerly, and the water temperature was approximately 85 degrees F.

The U.S. Coast Guard Marine Safety Office (MSO), New Orleans, was notified of the spill and the vessel was anchored at mile marker 75. The USCG Atlantic Strike Team's (AST) assistance was requested. Small, rainbow sheens of about 12 inches in diameter developed near the anchor site and the severely listing vessel. No other evidence of a spill was apparent.

EXXON hired Continental Shelf Associates (CSA) to sample the river bottom for oil. Sampling began on September 5 by AST and September 6 by CSA. At intervals of every mile between river mile 64.5 and 114, samples were taken from bank to bank. In all samples taken, very little oil was detected. EXXON Corporation was requested to provide data on the spilled material and its physical characteristics in fresh, brackish, and saltwater environments. They were also requested to conduct a study on the effects of the material on bottom-dwelling, filter-feeding species residing in the river outflow region.

Behavior of Oil:

Carbon black feedstock is a very heavy (API of 2.0 to -1.5, specific gravity of 1.1) liquid with a dark brownish color. It is also known as RFD Extract, Aromatic Concentrate, or Aromatic Tar and is used in the manufacture of carbon black. The carbon black feedstock, with a pour point of 73 degrees F, rapidly emptied out of the cargo tank and into the river. The oil appeared to be churned into tiny globules and droplets by the actions of the vessel's propwash. The oil quickly dissipated with the river currents.

Except for small traces of material obtained on weighted sorbent and in grab-sample casts conducted between mile markers 64.5 and 114, no significant amount of the original spill was ever detected. Directly below the vessel at the *Belle Chasse anchorage*, approximately 10 barrels of pooled oil was discovered and recovered. Overflight observers reported no other oil or sheen anywhere else on the river. No fish kills were reported as a result of this spill. All water intakes in the area remained open with no reports of contamination.

Countermeasures and Mitigation:

Hand leadlines wrapped with a *cotton rag* were lowered from a Strike Team utility boat and drug across the bottom in an attempt to locate oil. CSA used a water taxi equipped with LORAN C, Depth finder, and a winch to raise and lower sampling equipment. After intensive surveys detected no product within 0.5 miles of the grounding site, the survey team expanded the search area. At one mile intervals down the river, samples were collected across the river at various depths. Extremely small quantities of oil in the form of droplets or small globs were found, but only in deep locations. These samples were *fingerprinted* and compared to samples collected from the vessel. Ten of eleven samples were identified as the carbon black feedstock.

The use of absorbent pads attached to the underside of clump weights on the end of the winch wire determined that there were no major oil pockets except the one under the anchored vessel. No recoverable quantities of the original 23,000 barrels spilled between mile markers 114 and 100 were located.

At mile marker 75, where the *ESSO Puerto Rico* was anchored to regain stability and affect repairs, a small pool of residual spillage (about 10 barrels) was detected and recovered by *diving* and *suction operations*.

Other Special Interest Issues:

Lack of proper bottom sampling equipment slowed the process of evaluating the movement of the oil. Detection of the oil on the bottom was finally accomplished by improvising a sampling system (i.e. rags on a leadline). The determination that oil was being dispersed by the flow of the river possibly could have been made sooner had the correct sampling equipment been available.

The fuel tanks on the CG utility boat used by the Strike Team in this response did not have the capacity for extended operations. Two 55 gallon drums had to be carried on-board because of long travel times to fuel docks on the Industrial and Harvey Canals. Varnish in the fuel tanks occasionally broke up and clogged the fuel lines.

Interference and antenna locations made direct radio communications impossible. *Cellular phone use was an effective solution to the problem.*

An extensive Exxon planning meeting took place before active response actions were taken. In addition, response was delayed by logistics problems and late delivery of physical property information on the spilled product by Exxon. Estimates of river current velocities and bottom topography obtained from the U.S. Army Corps of Engineers differed substantially from actual conditions experienced by vessels on-scene.

References:

- Esso Puerto Rico Carbon Black Spill Response Preliminary Post Survey Report. Prepared for Exxon Shipping Co. Continental Shelf Associates, Inc. Jupiter, Fl, 14 September 1988.
- Golobs 1978-1989 US Spill Report
- Guidelines for Shipping Tanker Cargoes, Carbon Black Feedstock, ESSO Chemical Co., New York, NY
- MMS Worldwide Tanker Spill Database
- NOAA Spill Report
- Tanker Advisory Center, Inc. 1991 Guide for the Selection of Tankers. T.A.C. Inc. 1991.
- USCG On-Scene Coordinators Report
- World Information Systems. Tanker Losses in U.S. Waters: 1978-1990. World Information Systems. 1991.

Name of Spill: *Ethel H (II)*
Date of Spill (mmddyy): 02/04/77
Location of Spill: Hudson River, New York
Latitude: 41 21 N
Longitude: 073 57 W
Oil Product: No. 6 Fuel Oil
Oil Type: Type 4
Barrels: 10,000
Source of Spill: Tank Barge
Resources at Risk: Waterfowl, diving coastal birds, marinas, beaches, power plant water intakes.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Adverse weather conditions, wildlife impacts, wildlife rehabilitation.
Shoreline Types Impacted: Extensive wetlands, marshes, exposed rocky shores, sand/gravel beaches.
Keywords: Atlantic Strike Team (AST), Air-Deliverable Anti-Pollution Transfer System (ADAPTS), boom, vacuum truck, oil snares, manual removal, skimmer, high-pressure washing, fingerprinting, steam generators, Shell Solvent 70, lightering.

Incident Summary:

On February 4, 1977, at approximately 1900, the *Ethel H (II)* ran aground on Con Hook Rock in the Hudson River near West Point, New York, while being towed by the tug *McAllister Brothers*. The forward section of the barge began taking on water. Due to darkness and heavy ice conditions, none of the 60,000 barrels of No. 6 oil aboard the *Ethel H (II)* was observed to be leaking into the water at the time of the grounding.

At 0255 February 5, the dispatcher reported oil leaking from the #1 starboard tank on the *Ethel H (II)*. Oil was observed both north and south of the vessel, but did not reach the shore due to 12 to 20 inches of shorebound ice. By 1015, the *Ethel H (II)* had shifted partially off Con Hook Rock and was in danger of sinking. Tugs assisted to help prevent the barge from sinking. Sea Land Environmental Engineering Co, contracted by McAllister Towing Co., and the USCG Atlantic Strike Team (AST) arrived on-scene February 5. After oil was pumped from submerged tanks, the barge's list was reduced to 15 degrees. Once the barge was secured from sinking, Amerada Hess Corporation, owners of the *Ethel H (II)* and McAllister Towing Co., refused responsibility for clean-up of any oil in the Hudson River. The USCG took control of the cleanup, retaining Sea Land Environmental Engineering Company as the prime contractor.

Reports of oiled birds prompted the New York State Department of Conservation and the U.S. Fish and Wildlife Service to establish a primary bird cleaning center. Several marinas and boat clubs on the Hudson reported

oil impacts. Extensive cleanup efforts continued through April 14, funded by the federal 311(k) oil pollution fund.

Behavior of Oil:

No. 6 fuel oil is a heavy product with an API gravity that ranges from 7 to 14. On February 6, oil was reported two miles north and three miles south of the grounding area. Ice extending from the shore kept most of the oil from contaminating the shoreline. On February 8, oil soaked ice was observed extending north to Worlds End and south to the George Washington Bridge. Pockets of oil coated ice were observed at Peekskill Bay, Verplanck Point, and from Croton Point to East Haverstraw.

Overflights of the Greater New York area on February 10, revealed an 80 percent brash ice coverage with 75 percent being oil stained. Brown ice and stained shores were observed at the Harlem River, Gravesend Bay, and 79th Street Marina. A light sheen appeared in the middle of the Hudson River while the heaviest concentrations stayed close to the shoreline. The following day, oil entered the marsh area at Bowling Point.

Heavy black oil was reported coming ashore on Fire Island beaches on March 11 and April 11. Personnel on a Cedar Island beach survey conducted on April 7 reported moderate to heavy coverage of oil soaked debris, tarballs, and sludge from the eastern tip of the island extending two miles to the west.

On July 5, the Vice President of the Philipse Manor Beach Club alerted the Captain of the Port, New York, of the presence of oil on their beaches. Concentrations of black tar balls were found approximately two to four inches deep in the sand. Fingerprinting confirmed the oil to be from the *Ethel H (II)*. The oil soaked sand was removed by Coastal Services, Inc.

Countermeasures and Mitigation:

Air-Deliverable Anti-Pollution Transfer System (ADAPTS) pumps were used to pump approximately 19,000 barrels of oil from submerged tanks on the *Ethel H (II)*. The possibility of capsizing the barge prevented pumping of the exposed tanks. After lightering, the *Ethel H (II)* was afloat again and moved to Standard Tank Cleaning Co. Eight feet of water ballast was added to the tanks that had been holed, creating a "water bottom" to prevent further leaking of oil during river transit.

Sea Land Environmental deployed *boom* early in the spill at Iona Island and other potential impact areas. Boom was deployed at the Nuclear Power Plant Indian Point to protect the water intakes. On February 19, boom was deployed at the Marine Parkway Bridge. Three hundred feet of boom was deployed at Con Edison Indian Point to prevent the oil from flowing into the facility's intakes.

Ice and debris often clogged the skimmers. To solve this problem, *crews used a J-configuration of boom to divert pieces of debris and ice away* from the skimmer. The Lockheed skimmer was not self-propelled and was towed through the icy areas. Personnel could not be on board during transit due to instability from ice impacts. Oil congealed on the belts of the *Marco skimmers*. A *Cold Weather skimmer* was dispatched at Peekskill Bay.

Land-based *vacuum truck* operations began at Verplanck Point on February 8. Vacuum trucks were marginally effective due to heavy ice and severely cold weather.

Oil snares proved to be very effective in the adverse weather conditions. They were the only countermeasures capable of picking up oil between, on, and under pieces of ice. Snares were also used to wipe oil off rocks and pilings. *Manual removal methods using shovels, pitch forks, rakes, and plastic bags* were most effective at the northern spill site beaches.

Steam generators (Hotsies) and *high-velocity water streams* (Hydro-Laser) were used for shore cleaning on selected private and public waterfront areas. *Both methods produced excessive splash of the product* and could have led to further contamination. However, these methods were the most effective and efficient in cleaning steel bulkheads.

On February 11, the EPA representative requested that NOAA personnel determine the quantity of oil remaining in the water in an attempt to predict any possible effects. A February 14 NOAA survey detected no subsurface oil in the water column of the Hudson River.

Other Special Interest Issues:

Ice and cold weather created unusual problems for this response. Most oil recovery equipment is not made to deal with oil mixed with ice. The ice movement, magnified by tidal action, often stressed and broke boom. Skiffs and skimmers were unable to maneuver around the ice. Seven clean-up personnel fell into the water after slipping on icy areas. Ice and debris clogged the skimmers, especially the Marco skimmers.

Floating ice functioned as a natural boom, protecting the shoreline from the oil in some areas. Fast ice also performed a scouring action on the shore as it broke up and moved away. Because of the icy conditions, only a small number of waterfowl were present in the area at the time of the incident.

The bird cleaning station, first established on February 12 at the Hi Tor Animal Center, Pomona, New York, was moved to the Stoney Point Highway Department on February 13. National Audubon Society personnel cleaned birds using the chemical *Shell Solvent 70*. Since the solvent presented a human health hazard, protective gear was distributed to bird cleaners. Dead birds collected on the beach may have died from starvation and harsh weather rather than from the oil. The Stoney Point center reported that 60 birds were received, 52 were treated, and 17 died. On February 21, the center was moved back to the Hi Tor Animal Center.

References:

- MMS Worldwide Tanker Spill Database
- USCG On-Scene Coordinator's Report

Name of Spill: Exxon Bayway Refinery
Date of Spill (mmddyy): 01/02/90
Location of Spill: Arthur Kill, New York
Latitude: 40 38 N
Longitude: 074 14 W
Oil Product: No. 2 heating oil
Oil Type: Type 2
Barrels: 13,500
Source of Spill: Pipeline
Resources at Risk: wading birds, bird nesting beaches, diving coastal birds, gulls, waterfowl, mussels.
Dispersants: No
Bioremediation: Yes
In-situ Burning: No
Other Special Interest: Closure of shipping lanes or vehicle traffic routes, volunteer response and organization, research conducted, wildlife impacts, wildlife rehabilitation.
Shoreline Types Impacted: Sand/gravel beaches, extensive wetlands, saltwater marshes, coastal structures.
Keywords: Customblen, Atlantic Strike Team (AST), Clean Harbors Cooperative, boom, self-propelled skimmer, Marco skimmer, JBF skimmer, vacuum truck, shop vacuum, sorbent boom, pompoms, trenches, New York State Department of Environmental Conservation (NY DEC), New Jersey State Department of Environmental Protection (NJ DEP), Tri-State Bird Rescue Center, volunteers.

Incident Summary:

On January 2, 1990, at approximately 0300, an Exxon underwater pipeline located at the mouth of Morse Creek discharged approximately 13,500 barrels of No. 2 heating oil into the Arthur Kill waterway between New Jersey and Staten Island, New York. Exxon personnel notified the U.S. Coast Guard (USCG) as well as other involved agencies, and activated the Clean Harbors Cooperative (Coop). Exxon company volunteers had periodically received practical training on how to deploy boom and other Coop equipment. This previous training expedited the decision-making process and allowed Exxon to begin response efforts immediately.

Initial response efforts focused on containment of the spill as well as removal of the heaviest concentration of oil. Environmentally sensitive areas were protected with boom and skimmers that collected the heavier concentrations of free-floating oil. Since the incident occurred in January, few migratory birds were in the spill area. Even so, Tri-State Bird Rescue treated over 100 oiled birds that were recovered during the incident. Cleanup crews in the spill area found over 600 dead birds.

A cleanup committee, consisting of representatives from USCG, Exxon, NOAA, New York State Department of Environmental Conservation (NY DEC), New Jersey State Department of Environmental Protection (NJ DEP), and New York City Parks and Recreation, monitored cleanup progress until

the end of active recovery. On February 14, substantial deposits of fresh oil were found in sediments above peat areas on Pralls Island. Trenches were dug to collect oil for vacuuming.

By March 15, all areas were considered "clean" by the Federal On-Scene Coordinator (FOSC) except Pralls Island where further cleanup activity was postponed due to the arrival of wading birds that breed on the island. Exxon received permission to apply *Customblen*, a nutrient enhancer for bioremediation, in this area after the fall migration.

Behavior of Oil:

No. 2 heating oil has a minimum API gravity of 30, and a pour point between -6 and -27 degrees C. Reports from observers on early overflights described oil extending north into the marshes of Newark Bay as well as south to the southern end of environmentally sensitive Pralls Island. Oil spread from the area north of the opening of Arthur Kill to Tufts Point.

Observers on a January 4 overflight reported that the oil collecting in heavy concentrations in natural areas as well as behind booms had the black appearance of No. 6 oil. On January 5, observers reported sheens along the shores of Staten Island near Shooters and Pearl Islands. Oil concentrations were heavy near Gothels Bridge and Old Man Creek. Heavy concentrations of oil were stranded above the berm on the beaches from Cedar Point to Rossville.

By January 7, more oil was leaching out of contaminated sediments than floating in the water. The majority of the remaining water-borne oil was observable as rainbow sheens which were spotted in the south part of the Kills. No additional significant amounts of oil were observed by January 10. On January 13, Old Place Creek showed no impacts of oiling except in the immediate area of boom locations.

Areal extent of sheens continued to diminish for the next few weeks. Six to eight inch holes dug during a February 14 observation trip to Pralls Island quickly filled with dark unweathered oil. All other areas affected by the spill were considered clean.

Countermeasures and Mitigation:

Containment boom was deployed to protect sensitive areas and utilize natural collection areas between the north and south ends of Arthur Kill. Additional boom contained pockets of oil in Kill Van Kull and Newark Bay.

Heavy concentrations of floating oil and mousse in the open water, primarily between Howland Hook and Fresh Kills, were collected by *self-propelled skimmers*. Two Marco skimmers and one JBF Navy skimmer were used in addition to the skimmers provided by the Coop.

Where shoreline access permitted, *vacuum trucks* removed oil in contaminated areas.

Sorbent materials were used on affected shorelines until these mechanical methods proved more damaging than beneficial. The use of *sorbent boom* and *pompoms* allowed natural flushing which helped the cleanup process in areas where oil was stranded above the berm. Sorbents remained deployed in marsh creeks until all visible signs of contamination were gone.

Six-foot-long by one-foot-deep *trenches* dug in the intertidal coarse grain sediment of Pralls Island collected oil that was removed with *shop vacuums*. This approach recovered a considerable quantity of oil with minimal environmental disturbance. Vacuum operations were suspended in the spring due to the anticipated arrival of migrating birds.

Other Special Interest Issues:

In June 1990, *Customblen*, a *slow-release fertilizer*, was applied by Exxon Research and Engineering to selected areas of previously impacted shoreline on Pralls Island to enhance oil removal by increasing biological activity on the remaining oil. In an effort to minimize variability, Customblen was placed in bags containing beach substrate and a known quantity of oil. These bags were placed in two shallow trenches in the intertidal zone. Microbial counts, nitrogen/phosphorous levels, and total hydrocarbons were measured at the beginning and end of the application.

Results of the experiment in December 1990 showed no clear trend of increased biodegradation in the fertilized plots versus the control plots. Since Pralls Island has been impacted by many previous oil spills, indigenous microbial populations may have already adapted to the presence of hydrocarbons. Bioremediation may not have been effective on Pralls Island because this area previously contained high levels of nitrogen and phosphorus, which suggest that nutrients may not be a limiting factor for natural biodegradation. Cross-contamination of the plots through leaching of nutrients, may have also contributed to the inconclusive results of the experiment.

As of February 20, a total of 841 oiled birds had been collected. Six hundred ninety one were dead (including 40 that died at Tri-State Bird Rescue). Forty five percent (296) were gulls. Also recovered were 29 dead muskrats, 1 cottontail rabbit, 1 domestic cat, and 9 live diamond back Terrapin Turtles. The level of volunteer efforts to clean and rehabilitate birds reached 2,900 hours by February 20.

Exxon's pre-planning, familiarity with cleanup equipment, and involvement with government agencies were beneficial during this response.

To prevent vessel traffic from transiting the spill area, a safety zone was established from Howland Hook to Tuft's Point. Although the zone was maintained throughout the cleanup period, vessels were allowed to transit the area, at no-wake speed, five days into the response.

Because No.2 fuel oil is flammable, vacuum trucks had to be grounded. Barge transfers had to be performed "splash free" by loading the tanks through a hose from the bottom rather than spilling product in from the top.

The west side of Pralls Island had been previously impacted by two large asphalt spills. *The No. 2 fuel oil was acting like a thinner, actually "melting" tar mats which had formed during the previous spills.* Sausage boom placed along the shore collected the leaching oil.

References:

- Bubar, B.G. and Czarnecki, J.R. 1991. Response to the January 1990 Arthur Kill Heating Oil Spill, Oil Spill Conference Proceedings, 1991, pp. 259-261.
- Hoff, R. 1991. A Summary of Bioremediation Applications Observed at Marine Oil Spills. Report HMRB 91-2. Jan. 1991.
- NOAA Hotline Reports
- Oil Spill Intelligence Report. International Spill Statistics 1989-1990, Special Report, 3/28/91
- Oil Spill Intelligence Report. Oil Spills, International Summary & Review. 1989-1990

Name of Spill: *Exxon Valdez*

Date of Spill (mmddyy): 03/24/89

Location of Spill: Bligh Reef, Prince William Sound, Alaska

Latitude: 61 02 N

Longitude: 146 05 W

Oil Product: Prudhoe Bay Crude

Oil Type: Type 3

Barrels: 240,500

Source of Spill: Tank Vessel

Resources at Risk: Coarse gravel beaches, eroding bluffs, exposed bluffs, exposed rocky shores, mixed sediment beaches, sand/gravel beaches, sheltered bedrock bluffs, sheltered rocky shores, vertical rocky shores, whales, seals, Sea Otters, seal concentration areas, seal haulouts, whale migration routes, whale seasonal use areas, mustelids, rodents, deer, bears, mammal population concentration areas, intertidal feeding areas, diving coastal birds, waterfowl, alcids, shorebirds, wading birds, gulls, raptors, bird rookeries, bird migration stopover areas, bird migratory routes, bird critical foraging areas, fish, molluscs, crab, beaches, marinas, subsistence, officially designated harvest sites, State Parks, National Parks, commercial fisheries, fish aquaculture sites, archaeological sites, Native American Lands.

Dispersants: Yes

Bioremediation: Yes

In-situ Burning: Yes

Other Special Interest: Wildlife impacts, wildlife rehabilitation, closure of commercial fishing areas, closure of shipping lanes or vehicle traffic routes, human health and safety concerns, media interest, research conducted, unusual or experimental cleanup techniques, volunteer response and organization, logistical or operational problems, habitat impact due to cleanup operations.

Shoreline Types Impacted: Coarse gravel beaches, eroding bluffs, exposed bluffs, exposed rocky shores, mixed sediment beaches, sand/gravel beaches, sheltered bedrock bluffs, sheltered rocky shores, vertical rocky shores.

Keywords: Inipol, Customblen, skimmer, sorbent belt skimmer, rope mops, sorbents, boom, pompoms, Corexit 7664, Corexit 9580, Corexit 9527, BP 1100X, International Bird Rescue and Research Center (IBRRC), Regional Response Team, fingerprinting, lightering, manual removal, vacuum truck, disposal, high-pressure hot water washing, high-pressure washing, low pressure washing, water-washing, remote response, Side Looking Airborne Radar (SLAR), steam generators, volunteers.

Incident Summary:

On March 24, 1989, the tanker *Exxon Valdez*, en route from Valdez, Alaska to Los Angeles, California, ran aground on Bligh Reef in Prince William Sound, Alaska. The vessel was traveling outside normal shipping lanes in an attempt to avoid ice. Within six hours of the grounding, the *Exxon Valdez* spilled approximately 10.9 million gallons of its 53 million gallon cargo of Prudhoe Bay Crude. Eight of the eleven tanks on board were damaged. The oil would eventually impact over 1,100 miles of non-continuous coastline in Alaska, making the *Exxon Valdez* the largest oil spill to date in U.S. waters.

The response to the *Exxon Valdez* involved more personnel and equipment over a longer period of time than did any other spill in U.S. history. Logistical problems in providing fuel, meals, berthing, response equipment, waste management and other resources were one of the largest challenges to response management. At the height of the response, more than 11,000 personnel, 1,400 vessels and 85 aircraft were involved in the cleanup.

Shoreline cleanup began in April of 1989 and continued until September of 1989 for the first year of the response. The response effort continued in 1990 and 1991 with cleanup in the summer months, and limited shoreline monitoring in the winter months. Fate and effects monitoring by state and Federal agencies are ongoing.

Behavior of Oil:

Prudhoe Bay crude oil has an API gravity of 27.0, and a pour point of 0 degrees C. The bulk of the oil spilled from the *Exxon Valdez* was released within 6 hours of the ship's grounding. The general trend of the oil was south and west from the point of origin. For the first few days after the spill, most of the oil was in a large concentrated patch near Bligh Island. On March 26, a storm, which generated winds of over 70 mph in Prince William Sound, weathered much of the oil, changing it into mousse and tarballs, and distributed it over a large area. By March 30, the oil extended 90 miles from the spill site. Ultimately, oil would extend more than 500 miles from Bligh reef, oiling shorelines in Prince William Sound, the Kenai peninsula, the Alaskan peninsula and Kodiak island. Oil impacts in the Prince William Sound region were the most severe.

In addition to the storm of March 26, the spill occurred at a time of year when the spring tidal fluctuations were nearly 18 feet. This tended to deposit the oil onto shorelines above the normal zone of wave action.

The diversity in shoreline types in the affected areas led to varied oiling conditions. In some cases, oil was present on sheer rock faces making access and cleanup difficult, or rocky beaches with grain size anywhere from coarse sand to boulders, where the oil could percolate to a sub-surface level. The spill affected both sheltered and exposed (to high wave/weather action) shorelines. Once oil landed on a shoreline it could be floated off at the next high tide, carried to and deposited in a different location, making the tracking of oil migration and shoreline impact very difficult. This migration ended by mid-summer 1989, and the remaining cleanup dealt with oiled shorelines, rather than oil in the water.

Cleanup operations continued in the summer months of 1990 and 1991. By 1990, surface oil, where it existed, had become significantly weathered. Sub-surface oil, on the other hand, was in many cases much less weathered and still in a liquid state. The liquid sub-surface oil could give off a sheen when disturbed. Cleanup in 1991 concentrated on the remaining reduced quantities of surface and sub-surface oil.

Countermeasures and Mitigation:

The Alyeska Pipeline Service Company was immediately notified of the incident and sent a tug to the site to assist in stabilizing the vessel. At the time of the incident, the Alyeska spill response barge was out of service being re-outfitted. It arrived on scene by 1500 on 24 March. Alyeska was overwhelmed by the magnitude of the incident; by March 25, Exxon had assumed full responsibility for the spill and cleanup effort.

Deployment of boom around the vessel was complete within 35 hours of the grounding. Exxon conducted successful dispersant test applications on March 25 and 26 and was granted permission on March 26 to apply dispersants to the oil slick. Due to the large storm that began the evening of March 26, much of the oil turned into mousse. As dispersants aren't generally able to dissipate oil in the form of mousse, it was no longer practical to use dispersants on floating oil during this response.

On the evening of March 25, a test in-situ burn of oil on water was conducted. Approximately 15,000 to 30,000 gallons of oil were collected using 3M Fire Boom towed behind two fishing vessels in a U-shaped configuration, and ignited. The oil burned for a total of 75 minutes and was reduced to approximately 300 gallons of residue that could be collected easily. It was estimated that the efficiency of this test burn was 98 per cent or better. Again, continued in-situ burning was not possible because of the change in the oil's state after the storm of March 26.

Five dispersant trials took place between March 25 and March 28. Corexit 9527 was used for the trials. Four of the tests used C-130 aircraft with ADDS packs, and one test was applied from a DC-6 aircraft. By March 29 the Regional Response Team (RRT) decided that dispersants were no longer feasible.

Because there was not enough equipment to protect all the shorelines that could be impacted, Federal, state and local agencies collaborated to establish shoreline protection priorities. The agencies decided that fish hatcheries and salmon streams had the highest priority; accordingly, containment booms were deployed to protect these areas. *Five fish hatcheries in Prince William Sound and two in the Gulf of Alaska were boomed*, with the largest amount of boom deployed at the Sawmill Bay hatchery in Prince William Sound. On April 15, the Sawmill Bay hatchery was boomed with 30,500 feet of sorbent boom and 28,600 feet of containment boom in multiple layers. As many as 15 to 20 boats were used daily for tending the boom and oil recovery by towing sorbent boom. *Overall, the deflection of oil from the hatcheries was very successful.*

At the height of containment efforts, it is estimated that a total of 100 miles of boom was deployed. Almost all the types of boom available on the market were used and tested during the spill response.

Due to the size of the spill, it was necessary to employ inexperienced workers to deploy and tend booms, and this led to some boom being incorrectly used or handled, and sometimes damaged. Some boom sank because of improper deployment, infrequent tending, or leakage and/or inadequacy in the buoyancy system. Other problems included fabric tears in boom due to debris, and tearing at anchorage points from wave action. In some cases, ballast chains were ripped off during boom recovery if the boom was lifted by the chain. One estimate suggests that 50 per cent of the damage to larger boom came during boom recovery. For self-inflating booms, it was important to keep the inflation valves above the water during deployment so that the boom did not become filled with water and have to be replaced.

Since most of the containment boom was in 50 to 100 feet long sections, several lengths of boom usually needed to be connected for deployment. When several types of boom were used in one operation, there were often problems with incompatible connectors between different types of boom. Bailing wire and other adaptations were used in the field for these situations. A universal type of connector (ASTM connector) came with some booms, but these were difficult to handle and hook up at sea and were hard to open once they had been submerged in cold water. *Booms to be re-used were hand cleaned early on in the spill, and as the spill progressed were cleaned in one of the two barges with mechanical washing facilities.*

To contain oil on the open water, containment boom was towed between two vessels (usually fishing boats) to surround the oil and then the two ends of the boom were drawn together to close the loop and await collection by a skimmer.

Aerial surveillance was used to direct the deployment of booms and skimmers for open water oil recovery. Visual overflight observations as well as ultraviolet/infrared (UV/IR) surveys were used by the USCG and Exxon to track the floating oil. *Satellite imagery was also tested as a method to track oil but was not very useful* because of the infrequency of satellite passes over Prince William Sound (every 7 to 8 days), cloud cover, and lengthy turn around time for results.

The primary means of open water oil recovery was with skimmers. In general, most skimmers became less effective once the oil had spread, emulsified and mixed with debris. To save time, it was most practical to keep skimmer offloading equipment and oil storage barges near the skimmers.

Weir skimmers were useful for collecting fresh oil that was present in a thick layer on the water. As the oil became weathered and laden with debris, however, it was the simple weir skimmers that were the first to clog. Some of the larger weir skimmers had auger pumps with cutters for chopping debris and were able to collect oil for a longer time than the simple models.

Oleophilic disc skimmers also worked well while the oil was fairly fresh. Once the oil became viscous and associated with debris, these skimmers were not very effective.

An Egmolap brand paddle belt skimmer (Egmolap II) was used and was effective for heavy mousse and debris. It collected very little water under light sea conditions. A different paddle belt skimmer that was supplied by the Canadian Coast Guard clogged easily when working with viscous oil.

When using rope mop skimmers, it was important to maintain the smallest angle possible when lifting the skimmer out of the water, so that the oil did not run down the mop and back into the water. In situations where the oil was viscous, it was useful to cut down the diameter of the mop from nine to six inches and inject diesel oil into the ringers as the mop was being rung out.

The most used skimmers during the response were the *Marco sorbent lifting-belt skimmers* that were supplied by the U. S. Navy. Once oil became viscous, the sorbent part of the skimmer was removed and the conveyor belt alone was sufficient to pull the oil up the ramp. The pump that came with the skimmer had difficulty offloading viscous oil, so that other vacuum equipment was used to unload the collected oil. *The Marco skimmers were generally not used close to shore because they draw between three and four feet.* In general, the *paddle belt and rope mop skimmers were the most useful for recovery of oil from the shoreline.* The skimmers were placed on self-propelled barges with a shallow draft.

Sorbents were used to recover oil in cases where mechanical means were less practical. The drawback to sorbents was that they were labor intensive and generated additional solid waste. *Sorbent boom* was used to collect sheen between primary and secondary layers of offshore boom, and to collect sheen released from the beach during tidal flooding. *Pompoms* were useful for picking up small amounts of weathered oil. Towing of sorbent boom in a zigzag or circular fashion behind a boat was used to collect oil and was more efficient than towing the boom in a straight line. *Sorbent booms made of rolled pads were more effective than booms made of individual particles* because these absorbed less water and were stronger, and did not break into many small particles if they came apart.

During the *Exxon Valdez* spill response, a *hopper dredge* was used to collect oil for the first time in the United States. The oil was gathered using a containment boom, and the draghead of the dredge was placed under the boom below the oil surface. The oil was then sucked up and placed in storage containers on the dredge. The drawbacks to using the dredge were that it recovers large amounts of water with the oil and must be used offshore because of its deep draft.

To transfer the recovered oil, water, and debris mixture from the skimmers to temporary storage containers, vacuum equipment and positive-displacement pumps were used. Vacuum trucks on barges or air-conveyers were most useful when used with an open-ended suction hose with a diameter of 6 to 8 inches.

Early on in the response, storage space for recovered oil was in short supply. To combat the storage space problem, water was decanted from skimmers or tanks into a boomed area before offloading. As a result, the remaining viscous oil mixture was difficult to offload, the process sometimes taking up to 6 to 8 hours. High-capacity skimmer offloading pumps, in particular grain pumps, were the most useful in transferring viscous oil.

Because recovery equipment was in near constant use, several vessels were set up to perform field repairs and conduct preventive maintenance.

The oil remaining on the *Exxon Valdez*, was completely offloaded by the end of the first week in April 1989. After offloading operations were completed,

the tanker was towed to a location 25 miles from Naked Island in Prince William Sound for temporary repairs. Later in the summer of 1989, the vessel was brought to California for further repairs.

Shoreline assessment was a prerequisite for the implementation of any beach cleanup. Assessment provided geomorphological, biological, archaeological and oiling information that was used for the development of site specific treatment strategies. Cleanup operations were scheduled around specific activities such as seal haulout activity, seal pupping, eagle nesting, fish spawning, fishing seasons, and other significant events as much as possible.

In 1989, hoses spraying seawater were used to flush oil from shorelines. The released oil was then trapped with offshore boom, and removed using skimmers, vacuum trucks (useful for thick layers of oil) and boom (sorbent, snare, pompoms). *For hard-to-reach areas, or locations with weathered oil, heated seawater was used to flush oil from the shoreline.*

Converted vessels and barges were used for beach washing operations. It would take several days to outfit a conventional barge with the equipment needed to heat and pump the water. Smaller vessels that were used for beach washing early in the spill were re-outfitted for bioremediation later in the response.

Along with the large scale beach washing, manual cleanup, raking and tilling the beaches, oily debris pickup, enhanced bioremediation and spot washing were used to cleanup the oil. In some locations, oil was thick enough to be picked up with shovels and buckets. In addition, mechanical methods were used on a few sites, including the use of bulldozers to relocate or remove the contaminated beach surfaces. *Mechanical rock washing machines, which were manufactured for the spill, were not used to clean contaminated rocks and return them to the beach.*

Oiled storm berm was mechanically relocated in some cases so that these areas, which normally would not receive much wave action, would be more exposed and cleaned by natural processes. If the oiling in the berm was significant or persistent it was tilled to free the oil or washed to optimize the cleaning. Recommendations were made to restrict the movement of berm to the upper third of the beach to ensure its return to the original location.

Beach applications of dispersants were tried in several locations. Corexit 7664 was applied on Ingot Island, followed by a warm water wash. No significant change in oil cover or the physical state of the oil was observed as a result of the treatment. Some ecological impacts were observed in the treated areas. It appeared that the effects were largely due to the intensive washing more than the use of Corexit 7664, and were evident in intertidal epibenthic macrobiota.

In addition, the dispersant BP1100X was applied to a test area on Knight Island. Toxicology studies indicated that the upper and lower intertidal biota were different from pre-application communities the day after dispersant application, and returned to pre-treatment levels after seven days.

Exxon also tested the dispersant Corexit 9580 in Prince William Sound. The decision to approve a large scale test of Corexit 9580 in August was reached after an extensive program aimed at evaluating shoreline cleaning technologies. The monitoring program addressed three major issues: migration of oil and Corexit in shoreline sediments, the migration of sediments and oil in the nearshore environments, and the migration of oil in the water column, each being evaluated in the monitoring program. The dispersant's effectiveness and impact were then compared to mechanical shoreline cleanup methods, and this information was used to determine whether Corexit 9580 should be used for shoreline treatment. The Research and Development Committee evaluating the proposal for dispersant use recommended against broad-scale application of the product because tests had not adequately demonstrated that removal and recovery efficiency outweighed possible adverse effects. The committee recommended using Corexit only on Smith Island, subject to continued review of the effectiveness of recovery procedures by on-scene monitors.

In May of 1989, the Environmental Protection Agency (EPA) and Exxon conducted *bioremediation trials* at two test sites on Knight Island in Prince William Sound. On the basis of these tests and other trials later in the summer, Exxon recommended the use of the bioremediation enhancement agents, Inipol (*Inipol EAP22*, manufactured by Elf Aquitaine of France) and Customblen (*Customblen 28-8-0*, manufactured by Sierra Chemicals of California), and subsequently treated over 70 miles of shoreline in Prince William Sound with these agents.

Past scientific research had determined that sufficient numbers of hydrocarbon degrading bacteria existed naturally in Alaska. It was decided that the limiting factor in enhancing petroleum hydrocarbon degradation was the availability of nitrogen and phosphorus for the indigenous bacteria. As a result, bioremediation trials focused on agents that were basically "fertilizers," and contained no living microorganisms. Considerations in the selection of bioremediation agents included ease of application, the possibility of causing algal blooms and eutrophication in areas where nitrogen/phosphorus concentrations would remain elevated (such as sheltered bays and estuaries), the flushing of nutrients from the beach soon after application due to tidal action, and the possible toxicity associated with concentrations of nitrogen based compounds (such as ammonia).

Winter monitoring of the effects of bioremediation consisted of surveys of more than 20 beaches in Prince William Sound and the Gulf of Alaska. These studies determined that oil degradation had been enhanced on the shorelines monitored, but some debate existed over whether bioremediation was solely, or even largely, responsible.

Cleanup operations in 1989 ceased by the end of September. All parties involved in the response agreed that continuation of cleanup into the Alaskan winter would jeopardize the safety of cleanup crews. In addition, it was speculated that the winter storms in Alaska could significantly remove oil from shorelines, including sub-surface oil. By the end of the 1989 cleanup, more than 25,000 tons of oiled waste and several hundred thousand barrels of oil/liquid waste were collected and disposed of in landfills.

Cleanup in 1990 began in April and ended in September. Surveys in the spring of 1990 showed that oiling conditions had been reduced or changed over the winter. Surface oil in 1990 was significantly weathered but sub-surface oil was relatively fresh in some locations. *Cleanup techniques in 1990 focused more on manual methods of treatment such as hand wiping and spot washing as well as bioremediation.* Mechanical equipment was used on a few sites.

Bioremediation was more extensive in 1990, with 378 of the 587 shoreline segments treated that year receiving bioremediation application. In general, Inipol was applied in cases where surface oiling existed and Customblen slow release pellets were preferred for treating beaches with sub-surface oiling. Generally, beaches were given one to three treatments over several months. *Concern over the possible toxicity of Inipol led to recommendations for application of only Customblen on some sites.*

By the spring of 1991, the scope of the cleanup effort was greatly reduced. Manual cleanup, bioremediation, and very limited use of mechanical equipment were employed. Cleanup took place from May of 1991 through July of 1991.

An important observation that resulted from the Exxon Valdez oil spill was that natural cleaning processes, on both sheltered and exposed beaches, were in many cases very effective at degrading oil. It took longer for some sections of shoreline to recover from some of the invasive cleaning methods (hot water flushing in particular) than from the oiling itself.

Other Special Interest Issues:

The *Exxon Valdez* oil spill aroused more media and public interest (both national and international) than any other spill in U.S. history. Alaska is considered by many to be a pristine environment that includes many species of elsewhere endangered wildlife.

In an effort to absorb and use input from the multitude of groups concerned with the effects of the spill, the Interagency Shoreline Cleanup Committees (ISCC) were formed to monitor beach cleanup progress. The ISCCs focused on identifying strategic resource planning needs and consisted of representatives from Exxon, environmental groups, private landowners, native groups and state and Federal agencies. There were ISCCs formed in Homer, Kodiak, Seward and Valdez.

Concern over oil related wildlife mortality was intense during the spill. The grounding occurred at the beginning of the bird migration season. The U.S. Fish and Wildlife service estimated that mortalities directly related to the spill range from 350,000 to 390,000 birds, especially common and thick-billed murres, assorted sea ducks, bald eagles, and pigeon guillemots, 3,500 to 5,500 sea otters and 200 harbor seals. In addition, killer whales may have been affected by the spill as their numbers in the area declined shortly after the spill. Of the 1,630 birds (over 36,000 dead birds were collected) and 357 Sea Otters that were trapped and treated by the International Bird Rescue Research Center (IBRRC)-run facilities (established in Homer, Kodiak, Seward and Valdez in response to this spill), the total survival rate was 50.7 per cent for birds, and 62 per cent for sea otters. These survival rates are considered very good for oil impacted animals.

Unlike birds, sea otters had to be anesthetized to be washed which increases the risk to the animal, and increases the cost of rehabilitation. The Sea Otter rehabilitation program was complex, with a total of 29 veterinarians, and 9 veterinarian technicians scheduled to provide 24 hour care. The resulting cost of the sea otter rehabilitation program was at least \$51,000 per Sea Otter. The highest percentages of sea otter fatalities (60 per cent) were recorded in the first three weeks of the spill.

Due to the magnitude and remote location of the spill it was necessary to bring significant additional resources (equipment and personnel) to Alaska to respond to the spill. Most of the response equipment brought to Alaska early on in the spill had to be delivered by air. Since the Valdez airport could not handle aircraft larger than a DC-6 or a C-130, most large air cargo shipments went to Anchorage and were transferred to smaller planes. In addition, many of the facilities (such as barge hotels for personnel) and equipment (such as hot water beach washing barges) was designed specifically for this spill.

Most of the affected shorelines were inaccessible by land. Most of the cleanup operations were conducted from vessels. Initially, fishing boats and other available craft were used to house personnel. Later, a state ferry, Navy transport ships, camps established on deck barges, and a self-contained semi-submersible derrick barge was used for berthing.

Besides other logistical problems with assembling and organizing a large work force in a short time, the majority of the personnel involved in the cleanup effort had to be trained for their jobs as well as receive formal safety training.

There were commercial fisheries closings as a result of the spill and great concern over the potential negative effect on hatcheries. The Alaska Department of Environmental Conservation (ADEC) canceled the 1989 black cod season in Prince William Sound, banned fishing for Pacific herring and cut short the shrimp season as a result of the spill. It was determined in 1989 that at least 87 per cent of the herring spawning grounds in Prince William Sound were heavily oiled.

In the winter of 1989/1990 and again in 1990/1991 the National Oceanic and Atmospheric Administration (NOAA) conducted monitoring programs to determine the extent of the natural removal of oil over the winter, and identify treatment issues to be addressed in the coming cleanup seasons. These studies determined that removal of surface oil between September 1989 to February 1990, for exposed shorelines, was about 90 per cent; for sheltered shorelines and those with intermittent energy, the removal rates were 70 per cent. For sub-surface oil, the removal rate was approximately 55 per cent, though this varied with the depth of the sub-surface oil impacts.

Concern by Alaskan residents, in particular native villages, over the possible contamination of subsistence foods, led NOAA to conduct research addressing specific issues of subsistence food safety. In general, no quick

method existed to quantitatively assess food safety, but the overall guideline was that if the food had no visible oiling or had no oily smell it was probably safe for consumption.

The results of the NOAA study indicated that, in general, the aromatic contaminant level in fish varied little between affected areas and the unaffected reference site (Angoon, in southeast Alaska). The level of aromatic contamination in molluscs was higher than normal (tissue levels exceeded 100 ppb) in the areas of Windy Bay, Kodiak, Chenega Bay, and Old Harbor, with the highest levels occurring in samples taken from Windy Bay and Kodiak. Mollusc samples taken in other areas affected by the oil spill were generally comparable in levels of aromatic contaminants to samples taken from the reference site.

At the time of the *Exxon Valdez* oil spill, there were no national guidelines established to indicate the levels of aromatic contaminants acceptable in food. Results from the subsistence studies indicated that higher levels of carcinogenic aromatic hydrocarbons were found in smoked fish than in the unsmoked fish samples obtained after the *Exxon Valdez* spill.

References:

- Allen, A. A. 1991. Controlled Burning of Crude Oil on Water Following the Grounding of the *Exxon Valdez*. Oil Spill Conference Proceedings, 1991, pp. 213-216.
- Carpenter, et al. 1991. Marine Operations and Logistics During the *Exxon Valdez* Spill Cleanup. Oil Spill Conference Proceedings, 1991, pp. 205-211.
- Chianelli, et al. 1991. Bioremediation Technology Development and Application to the Alaskan Spill. Oil Spill Conference Proceedings, 1991, pp. 549-558.
- Ciancaglini, RADM D.E. 1991. The Federal On-Scene Coordinator's Role in the *Exxon Valdez* Oil Spill. Oil Spill Conference Proceedings, 1991, pp. 325-331.
- Dames and Moore 1991. Ecological Effects of BP1100X Shoreline Treatment on Knight Island Prince William Sound, Alaska.
- Dames and Moore 1991. Ecological Effects of Corexit 7664 Shoreline Treatment on Ingot Island Prince William Sound, Alaska.
- Glaser, et. al. 1991. Development and Evaluation of Application Techniques for Delivery on Nutrients to Contaminated Shoreline in Prince William Sound. Oil Spill Conference Proceedings, 1991, pp. 559-562.
- Gundlach, E. 1991. Shoreline Surveys at the *Exxon Valdez* Oil Spill: The State of Alaska Response. Oil Spill Conference Proceedings, 1991, pp. 519-529.
- Hayward Walker, A. and Field, L. J. 1991. Subsistence Fisheries and the *Exxon Valdez*: Human Health Concerns. Oil Spill Conference Proceedings, 1991, pp. 441-446.
- Hoff, R. 1991. A Summary of Bioremediation Applications Observed at Marine Oil Spills. Report HMRB 91-2.
- Jahns, et al. 1991. Natural Cleaning of Shorelines Following the *Exxon Valdez* Spill. Oil Spill Conference Proceedings, 1991, pp. 167-176.
- Michel, et al. 1991. Trends in Natural Removal of the *Exxon Valdez* Oil Spill in Prince William Sound from September 1989 to May 1990. Oil Spill Conference Proceedings, 1991, pp. 181-187.
- NOAA Hotline Reports
- NOAA Response Report
- Noerager, et al. 1991. Oil Tracking, Containment, and Recovery During the *Exxon Valdez* Response. Oil Spill Conference Proceedings, 1991, pp. 193-203.
- Teal, A. R. 1991. Shoreline Cleanup - Reconnaissance, Evaluation, and Planning Following the Valdez Oil Spill. Oil Spill Conference Proceedings, 1991, pp. 149-152.
- Varanasi, et al. 1990. NOAA Technical Memorandum NMFS F/NWC-191; Survey of Subsistence Fish and Shellfish for Exposure to Oil Spilled from the *Exxon Valdez*
- White, J. and Williams, T. 1991. Saving Endangered Species in Major Oil Spill Cleanup Efforts. Oil Spill Conference Proceedings, 1991, pp. 221-223.
- Wood, M. and Heaphy, N. 1991. Rehabilitation of Oiled Seabirds and Bald Eagles Following the *Exxon Valdez* Oil Spill. Oil Spill Conference Proceedings, 1991, pp. 235-239.
- World Information Systems. 1991. Tanker losses in U.S. Waters 1978-1990.

Name of Spill: Funiwa No. 5
Date of Spill (mmddyy): 01/17/80
Location of Spill: Niger Delta, Forcados, Nigeria
Latitude: 05 00 N
Longitude: 005 00 W
Oil Product: Nigerian Crude
Oil Type: Type 3
Barrels: 200,000
Source of Spill: Platform
Resources at Risk: Demersal fish, crabs, mangroves, shrimp, oysters.
Dispersants: Yes
Bioremediation: No
In-situ Burning: No
Other Special Interest: Habitat impact due to oil, wildlife impacts.
Shoreline Types Impacted: Mangroves, sand/gravel beaches.
Keywords: Gold Crew, International Tanker Owners Pollution Federation (ITOPF), blowout, relief well, fire.

Incident Summary:

On January 17, 1980, the Funiwa No. 5 well blew out. Approximately 200,000 barrels of oil spilled from the well, five miles off the Niger Delta, Nigeria. On January 29 the oil ignited. The flow of oil stopped on February 1 as the Funiwa No. 5 bridged.

Behavior of Oil:

Oil impacted the Nigerian coast on February 1, killing fish and crabs. Onshore winds and the incoming tide carried the oil into the Niger River delta. Oil heavily impacted the beaches between Fishtown and Sangana village. Lighter concentrations of oil impacted the land between the Middleton and Nun Rivers. Some of the oil evaporated on the water, and some drifted out to sea.

Countermeasures and Mitigation:

Red Adair Corporation attempted to cap the well, but abandoned the effort due to danger to personnel. Two rigs were brought on scene to dig relief wells, however, the Funiwa bridged before they were completed.

Cleanup operations consisted mainly of application of 8,800 gallons of *Gold Crew dispersant*. Dispersants were spread near Otuo village and Sangana town.

While the mangroves tended to retain the oil, sand beaches were cleaned by wave and tide action.

Other Special Interest Issues:

Oil was retained in the Santana mangroves, killing crabs, winkles and mangrove tree seedlings. The larger seedlings and the mature trees were healthy. *Approximately 836 acres of mangroves were destroyed by the oil.*

References:

- Genwest Systems, Inc. communications with ITOPF representatives.
- Nigerian Well Spills 8.4 Million Gallons of Oil. Oil Spill Intelligence Reports. February 8, 1980, Vol. III, No. 6. p.1.

Name of Spill: *General Colocotronis*
Date of Spill (mmddyy): 03/07/68
Location of Spill: Eleuthera Island, Bahamas
Latitude: 25 20 N
Longitude: 076 20 W
Oil Product: Venezuelan crude oil, diesel fuel
Oil Type: Type 3, Type 2
Barrels: 37,700
Source of Spill: Tank Vessel
Resources at Risk: Coral reefs, recreational beaches, crabs, lobster.
Dispersants: Yes
Bioremediation: No
In-situ Burning: Yes
Other Special Interest: Adverse weather conditions, complex salvage operations, research conducted, effects to tourism, unusual or experimental cleanup techniques.
Shoreline Types Impacted: Coral reefs, fine sand beaches.
Keywords: Enjay 7664, Magnus, Drew, Polycomplex A, boom, International Tanker Owners Pollution Federation (ITOPF), lightering, sinking.

Incident Summary:

On March 7, 1968, the Greek tank vessel *General Colocotronis* ran aground on the east side of Eleuthera Island in the Bahamas. The vessel was loaded with approximately 119,000 barrels of Venezuelan crude oil. The hull was severely damaged during the grounding causing the vessel to spill approximately 37,000 barrels of oil into the Atlantic Ocean at a location one and one-half miles offshore.

Approximately 72,500 barrels of oil were pumped from the vessel into another tanker, the *Esso Margarita*. Steam lines were rigged to heat the cargo to facilitate pumping. Moving the salvage vessels into position and offloading the remaining cargo was performed during extremely severe weather.

Dive surveys reported that the keel was crushed and buckled and that there was extensive damage to the hull of the vessel. Salvage and response personnel decided that the only feasible action was to sink the *General Colocotronis*. Following the offloading operations, the cargo tanks were flushed with dispersants to remove the residual oil. The vessel was then towed out to deep water and sunk.

Behavior of Oil:

Approximately 37,000 barrels of crude oil rapidly spilled from the *General Colocotronis*. The resulting slick spread out along the coast and caused impacted recreational beaches and private residential shoreline. In addition to the spilled cargo, an unknown quantity of the vessel's diesel bunker fuel also leaked out.

The oil impacted the sands of Eleuthera, in some cases penetrating deep into the beach sand and forming layers as thick as two inches. The coral reef was covered with oil. The slick offshore was 14 miles long by two miles wide.

Countermeasures and Mitigation:

The primary response tool for this spill was *chemical dispersant*. Four types of dispersants were reportedly used during the cleanup operation: *Enjay 7664*, *Magnus*, *Drew*, and *Polycomplex A*. A total of 10,900 gallons of dispersants were used to combat the oil slick. The water-based Enjay 7664 was only recently on the market at the time of the spill and was proven by tests conducted at Eleuthera to be of low toxicity. Polycomplex A was also water-based. Magnus was a light-oil base and was used in limited amounts. Drew was a kerosene based product that produced a slight skin-irritation to the cleanup personnel who worked with it. Tropical weather conditions reportedly made personal protective equipment impractical.

Oil was sprayed with detergents while it was still on the water but close to the shoreline. This was done by spraying the detergent into the breakers from on shore or from a small boat close to the shore.

There was a very high rate of "bio-erosion" that effectively cleaned the intertidal coral reefs. Particularly noted were the *chiton* and other browsing molluscs. They were shown to clean up oil on the reefs rapidly.

Sea grass and *Sargassum weed* were natural sorbents. These weeds washed up on the shore naturally and absorbed the oil as it hit the beach.

Boom was used at the north end of the beach at French Leave. This booming was felt to have only psychological value and it was not believed that the boom could have held back the heavy crude oil.

Other Special Interest Issues:

A test of burning dry weed that had been used to mop up oil was conducted. This was determined to be impractical on a larger scale as the fire was quickly buried in sand or wet weeds. There was also a potential risk of the fire spreading to the dry scrub in the back-beach area.

Foam tankers and pump trucks for fire fighting were used in the dispersant spraying operation. They were used from the beaches and from landing craft.

This spill occurred four days after the *Ocean Eagle* spill in Puerto Rico. Most of the media attention was focused on that incident. There were no reported adverse effects to the tourist industry of the area as a result of the spill.

References:

- Genwest Systems, Inc. communications with ITOPF representatives.
- Gilmore et al. 1970. Systems Study of Oil Spill Cleanup Procedures. Vol.1: Analysis of Oil Spills and Control Measures.
- Hooke, N. Modern Shipping Disasters 1963-1987. Lloyds of London Press. 1987.
- Potter, J. 1973. Disaster By Oil. The Macmillan Company, NY. pp. 119-151.

Name of Spill: *Globtik Sun*
Date of Spill (mmddyy): 08/15/75
Location of Spill: Gulf of Mexico
Latitude: 28 20 N
Longitude: 093 03 W
Oil Product: Arabian Crude oil
Oil Type: Type 3
Barrels: 7,000
Source of Spill: Tank Vessel
Resources at Risk: Commercial fishing.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Logistical or operational problems.
Shoreline Types Impacted: None
Keywords: Fire, collision, salvage, lightering.

Incident Summary:

At 0130 on August 15, 1975, the *M/V Globtik Sun* struck an unmanned Chevron Oil Company oil production platform approximately 100 miles from Galveston while en route from Aruba to Baytown, Texas. The platform, designed for 12 oil wells, was unmanned because it was not yet in operation. Approximately 7,000 barrels of oil spilled into the Gulf of Mexico after the vessel's port bow tank ruptured. As flames engulfed the vessel, the master gave the order to abandon ship. Forty of forty-six crew members were rescued, three charred bodies were found on board the ship August 17, and three crew members were lost at sea. Weather at the time was mild with clear skies, wind at 10 knots out of the SW, and seas 1-2 feet.

Apparently, the ship was on autopilot with the radar turned off when the watch was relieved at midnight. The charts that were in use were not up-to-date and showed no fixed structures on the ship's trackline. When the radar was turned at 0030, nothing was visible. At 0045, the radar revealed an object approximately 9 miles away on the starboard side of the vessel. The Captain of the vessel claimed that he saw no navigational lights on the platform even though a Chevron spokesman said they were functioning properly. The mate failed to plot the object. At 0130, the port bow of the vessel struck the eastern side of the platform, opening up a gash 2 feet wide by the length of the bow tank. The cargo ignited and the fire spread towards 15 drums of lube oil. An emergency call was made and the ship was abandoned while fire and smoke engulfed the forward port section of the ship.

Personnel working on other platforms in the area immediately responded to the accident. Six utility boats surrounded the *Globtik Sun* within 30 minutes. Two Coast Guard cutters and four aircraft arrived on-scene on August 15. The charred vessel was towed by McAllister Towing to Galveston on August 18. The *Globtik Sun* was later sold for scrap.

Behavior of Oil:

An oil slick about two miles long and half a mile wide leaked out from the vessel's damaged port bow. The majority of the oil slick was on fire and burned off, so no cleanup of oil on the water was required. Survivors of the incident reported encounters with flames and oil in the water. By the morning of August 16, only a very light, rapidly dissipating sheen was reported.

Countermeasures and Mitigation:

After the fire was controlled, the vessel was towed and anchored off the coast of Galveston for inspection and lightering.

Other Special Interest Issues:

References:

- 8/9/91 & 8/28/91 Letters from Daniel Owen at ITOPF
- Genwest Systems, Inc. communications with ITOPF representatives.
- MMS Worldwide Tanker Spill Database.
- U.S. Coast Guard POLREP file.

Name of Spill: *Grand Eagle*
Date of Spill (mmddyy): 09/28/85
Location of Spill: Delaware River, Marcus Hook, Pennsylvania
Latitude: 39 50 N
Longitude: 075 25 W
Oil Product: Ninian Crude Oil
Oil Type: Type 3
Barrels: 10,357
Source of Spill: Tank Vessel
Resources at Risk: Bird migratory route, bird wintering concentration area, marshes.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Effects to recreation areas, habitat impact due to cleanup operations, habitat impact due to oil, wildlife impacts, logistical or operational problems, research conducted.
Shoreline Types Impacted: Exposed seawalls, riprap, marshes, coarse sand beaches, coarse gravel beaches, tidal mudflats.
Keywords: Vegetation cutting, water-washing, high pressure washing, low pressure washing, Tri-State Bird Rescue Center, New Jersey State Department of Environmental Protection (NJ DEP), Delaware Bay and River Cooperative, U.S. Navy Superintendent of Salvage (NAVSUPSALV), manual removal, boom, disposal, sorbent pads, vacuum truck.

Incident Summary:

At 2330 on September 28, 1985, the Panamanian Tank Vessel *Grand Eagle*, loaded with 530,659 barrels of Ninian Crude oil, ran aground in the Delaware River near Marcus Hook, Pennsylvania. A cargo tank ruptured causing the *release of 10,370 barrels of oil* into the waterway, impacting a 12 mile section of the river and the surrounding shoreline. The weather at the time of the accident was clear with broken cloud coverage. Winds were NNW at 17-21 knots and the temperature was 68°F.

The U.S. Coast Guard (USCG) was notified immediately. The On-Scene Coordinator (OSC) supervised all response and cleanup operations from September 28 to November 8, 1985.

The *Grand Eagle* was freed from its grounding site at 0040, September 29 and was moved to the Sun Oil Company Refinery at Marcus Hook where the remaining cargo was offloaded.

The OSC authorized movement of the vessel with tug escort to Pennsylvania Shipbuilding in Chester, Pennsylvania to begin repairs on the damaged cargo tank. Oil was boomed away from the vessel before beginning the moving operation, and a skimmer remained with the vessel to collect any oil lost during transit. The vessel was moved without incident, and there was no significant loss of oil from the containment area.

Behavior of Oil:

Ninian crude oil has an API gravity of 35.5, and a viscosity of .42 centistokes. The initial trajectory predictions suggested that the oil would move rather rapidly down river, influenced both by the tides and the increased flow rate of the river due to the recent effects of Hurricane Gloria. Wind conditions at the time of the spill indicated that the New Jersey shoreline would be the main area impacted. By 0630 on September 29, the oil slick extended over about 9 miles of the Delaware River. By the following morning the oil had spread in ribbons south of the Delaware Memorial Bridge to Pea Patch Island, about 14 miles down the river from the grounding site. Oil impacted on both the New Jersey and Delaware shorelines between the Commodore Barry Bridge and to the south of the Delaware Memorial Bridge. By October 1, most of the floating oil had landed on the beaches and in the marshes.

The primary areas impacted were *mixed sand and gravel beaches, riprap*, manmade harbor structures, and *marshlands*. Also affected was the Battery Park in New Castle, Delaware, a high use recreation area. The intertidal zone including riprap at the park was heavily oiled. Marshes fringing the park were heavily oiled within a tidal interval of one meter. Oil was scattered across the tidal flats in small patches and covered the sand in large mats. Oiled debris was present in the marshes, on the tidal flats, and on the beaches.

Aquatic birds and the marsh areas they inhabit were felt to be the most seriously threatened resources in the area of the spill. Of particular concern was the Salem River because of its extensive wetlands. *Approximately 78 acres of marshland were moderately-to-heavily oiled* (one of the largest recorded events of oil impact on marshland).

The main areas of socioeconomic concern were the Battery Park and the Christiana River. Industry in the area attempted to carry on normal operations. In one case, an unattended boom was removed for ship passage and was not replaced, resulting in lost oil from the containment area.

Approximately *8,060 barrels of oil were recovered* through the efforts of the DELBAY skimmer, the 5 Navy skimmers, and vacuum trucks. Recovered oil and oiled debris were taken to the Sun Oil Refinery for disposal. Over twenty-five hundred cubic yards of debris were removed. Cleanup and inspection operations continued until November 8.

Countermeasures and Mitigation:

Following the grounding, *booms* were placed around the vessel. Booms and *vacuum trucks* were used between the Commodore Barry Bridge and the Delaware Memorial Bridge.

The skimmer *Delbay* began skimming at the leading edge of the slick on 29 September. It stayed in operation until October 6. It escorted the vessel from the Sun Oil Terminal to the shipyard on October 1, and was used in the

Christiana River to collect refloated oil from shore washing on October 5. Five skimmers, requested from the U.S. Navy Supervisor of Salvage (NAVSUPSALV), were working in the Christiana River area on October 2.

The National Oceanic and Atmospheric Administration (NOAA) Scientific Support Coordinator (SSC) nominated the Salem River, Pea Patch Island, and the marsh area to the south as areas of immediate concern. Due to the vessel owner's inability to protect the marshes adequately, the OSC declared a *limited federally funded spill response* to the area south of the Delaware Memorial Bridge. On October 1, a containment boom was placed across the Salem River, and 10,000 feet of diversionary boom was deployed to protect the Salem Cove area.

There was limited *grass cutting* in the vicinity of the Commodore Barry Bridge and in the marsh grass at Battery Park, after *water-washing* proved to be ineffective against pooled oil. The marsh grass in the Commodore Barry Bridge vicinity was on the New Jersey side of the river, and the cutting was done at the specific request of the *New Jersey State Department of Environmental Protection (NJ DEP)*. This area was cut to lessen the threat of contamination to aquatic birds in the marsh. Some marsh grass was cut at New Castle's waterfront park and near Deemer's Beach. NOAA *recommended that the marsh grasses not be cut*, as this practice could allow the oil to penetrate the tissues of the plants more readily, and it would allow the oil to get deeper into the marshes. NOAA advised that damage could occur to non-oiled plants in the course of cutting the oiled ones, through trampling plants and introducing oil into previously uncontaminated areas. In the marshes of Oldman's Creek and Raccoon Creek, the initial booming failed due to untended and improperly secured boom. Small boats were used to access the oiled areas. Sorbent pads were used to collect the loose oil. The contractors found that the *marshes were naturally cleaned with each change in the tide*.

NOAA recommended using *high- and low-pressure washing* of the oil from man-made features (*seawalls and riprap*) into sorbent booms to be collected by surface skimmers. *Low-pressure washing* was used to flush out the shoreline rock and grass area near the Wilmington Marine Terminal. This method was highly successful. The extensive bulkheads in the residential Pennsgrove area were cleaned by hand-wiping. Seawalls were cleaned by hand-wiping and scrubbing; NOAA recommended using high pressure washing or steam cleaning. *Coarse grain sand beaches* were manually cleaned with rakes and shovels after all the oil was onshore. Low pressure flushing was ineffective at Battery Park and Deemer's Beach.

At the height of activity, there were 442 people involved in the cleanup. Cleanup equipment included 27 vacuum trucks, 6 skimmers, a barge and tug to service the skimmers, 47 small boats, 32 vehicles, and 59,695 feet of containment/sorbent booms.

Pollution monitors observed a contractor using *Aquamix*, an organic based mixture used to clean vessel cargo tanks, to clean the rocks at Christiana Park.

The contractor felt that very little of the Aquamix had gotten into the water. However, NOAA advised that this product was unsafe for use in the marine environment, and its use was subsequently discontinued.

Other Special Interest Issues:

Approximately two hundred birds were believed affected by the spill. Ninety-two oiled birds were taken to the *Tri-State Bird Rescue Center*. All of the thirty-five ducks, geese and gulls recovered. Of the fifty-seven cormorants recovered, only three survived. There were no reports of damage to fish or shellfish. Samples taken from bottom sediments showed negligible impact.

The Navy skimmers collected approximately 70 barrels of oil. The USCG reported that an immediate partial federal response would have made the skimmers accessible sooner when they would have been more effective.

The *Delaware Bay and River Cooperative* (DELBAY COOP) was formed by oil companies in Pennsylvania, New Jersey, and Delaware for oil spill prevention and cleanup. The *Grand Eagle* owners were not DELBAY COOP members, and thus could not direct the use of COOP equipment, including the skimmer *Delbay*. The OSC was allowed to direct the deployment of the COOP's equipment, following the activation of cleanup efforts by Sun Oil Company, which is a member company.

References:

- GOLOB, 1978-1989 U.S. Spill Report.
- MMS Worldwide Tanker Spill Database.
- Oil Spill Intelligence Report. Oil Spills, International Summary & Review, 1982-1985.
- Tanker Advisory Center, Inc., 1991 Guide for the Selection of Tankers.
- U.S. Coast Guard On-Scene Coordinator's Report.

Name of Spill: Hackensack Estuary, Tank Farm
Date of Spill (mmddyy): 05/26/76
Location of Spill: Hackensack, New Jersey
Latitude: 40 44 N
Longitude: 074 11 W
Oil Product: No. 6 Fuel Oil
Oil Type: Type 4
Barrels: 47,619
Source of Spill: Facility
Resources at Risk: Marinas, waterfowl, wading birds, shorebirds, gulls, crabs, bird nesting sites.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Innovative cleanup techniques, wildlife impacts, habitat impact due to oil.
Shoreline Types Impacted: brackish marshes, tidal mudflats, vegetated riverbanks.
Keywords: Containment boom, vacuum truck, reoiling, vegetation cutting, disposal.

Incident Summary:

On the morning of May 26, 1976, 47,619 barrels of No. 6 oil spilled into the Hackensack River estuary from the Wellen Oil Company tank farm in Jersey City, New Jersey. The oil moved upriver on incoming tides, and oiled marshes, mudflats, and the banks of the Hackensack River. Cleanup operations were supervised by the United States Coast Guard and the Hackensack Meadowlands Development Commission.

Behavior of Oil:

No. 6 fuel oil is a heavy product with an API gravity that ranges from 7 to 14. The oil initially entered the river and its estuaries on the ebbing of the tide, and moved downriver where it was contained by a boom. Late on May 26 the oil slick moved upriver due to the incoming tide and winds. The riverbank was oiled as far north as Snake Hill. By the morning of May 28, the riverbank and the marshes as far north as Secaucus were oiled. The Sawmill Creek Wildlife Management Area was heavily oiled. Reoiling occurred with each tidal cycle. By May 29, there was little oil in the water, since most of the oil was deposited on the marshes, mudflats, and riverbanks.

Countermeasures and Mitigation:

On May 26, 2,000 feet of boom was deployed across the Hackensack River, downriver from the spill source, to contain the oil. Once in place, efforts turned to the preventive booming of the tributaries entering the Sawmill Creek Wildlife Management Area which is upriver from the source of the spill. On May 27, *river currents reached 4 knots during the flood tide. Booms placed across the river and tributaries failed.* Subsequently, the oil entered the marsh and mudflat areas.

Oil on the water was recovered by mop-cats and vacuum trucks. On June 13, Disch Construction Company began cutting the oiled vegetation (primarily Salt Marsh Cordgrass) along the banks of Hackensack River. These operations removed the oil-coated marsh grasses to prevent re-oiling by oil floated off the riverbank by the tide. The grasses in the inner marshes and tidal bays were not cut. Responders felt that the harvesting of inner marsh areas would do more harm than good. It was also decided that the marshes, mudflats, and tidal bays received adequate tidal flushing to sufficiently clean those areas. A total of 7900 feet of riverbank vegetation was cut during the 17 day operation. The harvesting of the grass was done with scythes and pitchforks. The oiled grass was transported by boat to a temporary storage location on the river bank. The storage location had neither a protective ground cover, nor a boom placed between it and the Hackensack River. Some oil leached out of the debris into the ground and river, both at the harvesting site and at the storage location.

Later studies of the cut areas showed that the riverbank vegetation recovered more quickly where grass cutting began soon after the oiling. There was a high mortality rate among the Salt Marsh Cordgrass that was oiled but not cut.

Other Special Interest Issues:

Several dead, oiled birds and oiled bird nests containing eggs were found. Subsequent inspections of nests showed that some were abandoned. Waterfowl and shorebirds oiled by the spill included Mallards, Black Ducks, Gadwalls, Green-Winged Teals, Blue Winged-Teals, Black Crowned Night Herons, Least Bitterns, Snowy Egrets, Florida Gallinules, Gulls, and Yellow-Leg Sandpipers.

The greatest observed impacts were to marsh and red-jointed fiddler crabs. The crabs displayed signs of stress and sluggishness and the males displayed late breeding colors. Crabs along the riverbank were more severely affected than those in the marsh and mudflat areas where tidal flushing was greater. Diamondback Terrapins were also affected, and showed difficulty in moving.

Damage to salt marsh cordgrass was due to smothering by the oil, and not to the chemical properties of the oil.

References:

- Dibner, P. 1978. Response of a Salt Marsh to Oil Spill and Cleanup: Biotic and Erosional Effects in the Hackensack Meadowlands, New Jersey. A report prepared for Industrial Environmental Research Lab. 1978.
- Mattson, et al. 1977. Hackensack estuary oil spill: Cutting oil-soaked marsh grass as an innovative technique, Oil Spill Conference Proceedings, 1977, pp. 243-245.

Name of Spill: *Hamilton Trader*
Date of Spill (mmddyy): 04/30/69
Location of Spill: Liverpool Bay, England
Latitude: 53 30 N
Longitude: 003 20 W
Oil Product: No. 6 Fuel Oil
Oil Type: Type 4
Barrels: 4,000
Source of Spill: Tank Vessel
Resources at Risk: Diving coastal birds, waterfowl, alcids, shorebirds, shrimp, recreational beaches, fish, commercial fisheries, high use recreational fishing areas.
Dispersants: Yes
Bioremediation: No
In-situ Burning: No
Other Special Interest: Wildlife impacts.
Shoreline Types Impacted: Sand/gravel beaches, exposed rocky shores.
Keywords: Corexit 7664, manual removal, International Tanker Owners Pollution Federation (ITOPF), collision, detergent.

Incident Summary:

Early on the morning of April 30, 1969, the *Hannes Knuppel* collided with the tanker *Hamilton Trader* in Liverpool Bay in the Irish Sea. The *Hamilton Trader* was anchored near the Bar Light Vessel at the time of the collision. A starboard tank on the *Hamilton Trader* was holed and approximately 4,000 barrels of No. 6 Fuel Oil was spilled. The spilled oil impacted approximately 50 miles of shoreline. Cleanup was accomplished primarily with chemical dispersants on the oil slicks at sea.

Behavior of Oil:

No. 6 fuel oil is a heavy product with an API gravity that ranges from 7 to 14. At around 1500 April 30, a Lancashire and Western Sea Fisheries vessel reported a three-mile long slick extending southwest of the collision site. On May 1, a slick six miles long extended to the northeast. On May 2, the slick was 3 miles long by 2.5 miles wide and was 9 miles north of Rhyl, Wales. The slick had dispersed somewhat by this time. The oil moved west to a point 10 miles north of Great Orme Head, Wales and remained there for two days. By May 7, the slick was 20 miles long and extended from 10 miles off Colwyn Bay to Red Wharf Bay.

Oil was driven to the north, and came ashore on May 11. Three miles of beaches near Selker Bay, England were oiled. By May 21, the oil had impacted various English beaches as far north as Allonby in the Solway Firth. A total of 50 miles of shoreline were affected. The worst impacts were at Gutterby, St. Bees Head, Fleswick, and Selker Bay.

Pollution on the beaches took the form of large patches of liquid oil. Near St. Bees Head, there was a thick coating of oil at the high water mark, but the sand lower on the beach stayed clear.

Black oil patches on the western shore of Walney Island were not determined to be of *Hamilton Trader* origin. Other beaches along the Lancashire coast, particularly near Blackpool and Fleetwood, were contaminated with oil which was not *Hamilton Trader* oil.

Countermeasures and Mitigation:

During the first two days of the response, the oil remained fairly concentrated in an area where no fishing occurred, but nothing was done to combat the spill at this time. Cleanup operations did not begin until May 2.

Esso Petroleum Company Ltd., the owners of the *Hamilton Trader*'s cargo arrived in Liverpool on May 1 with dispersants. *On May 2, Esso personnel began spraying dispersant on the slick off of Wales.* Corexit 7664 was applied by a fishing vessel, a launch and two aircraft operating out of Rhyl, Wales. *Dispersant operations ended on May 4, after some success in dispersing light sheen.* The two aircraft were incapable of operating out of sight of land. They were also restricted by poor visibility, thus they only performed limited spraying operations.

The Corexit 7664 was effective in dispersing thin oil slicks. It was applied in a 3 or 4 per cent solution with seawater. It was not possible to judge its effectiveness against thicker oil, as none was sprayed. Esso representatives said that it would not effectively disperse thicker oil patches, but only break them up. The spraying did not appear to have any adverse biological effects, as it was performed over deep water.

On Walney Island, approximately *30 gallons of detergent were reportedly used on the beach* near Thorney Nook. Oil that impacted the west side of the island was removed mechanically. Oil was cleaned from the beaches on the Cumberland coast using mechanical equipment.

Other Special Interest Issues:

An estimated 5,000 seabirds were killed by the oil. Most of the dead birds were auks. Terns and Black-headed Gulls were oiled when the oil came ashore at Sellafeld and St. Bees Head, England, on May 12.

Several important fisheries on the North Wales coast and along the Mersey Estuary were threatened by the spill. Favorable winds from the east kept the oil from impacting these sensitive areas, which included flatfish and shrimp fisheries.

References:

- Genwest Systems, Inc. communications with ITOPF representatives.

Name of Spill: Hasbah 6
Date of Spill (mmddyy): 10/02/80
Location of Spill: 250 km NW of Qatar, 140 km N of Saudi Arabia, Gulf of Arabia
Latitude: 20 10 N
Longitude: 050 00 E
Oil Product: Crude Oil
Oil Type: Type 4
Barrels: 100,000
Source of Spill: Platform
Resources at Risk: Power plant water intakes, drinking water intakes, fish.
Dispersants: Yes
Bioremediation: No
In-situ Burning: No
Other Special Interest: Unusual or experimental cleanup techniques, wildlife impacts.
Shoreline Types Impacted: Sand/gravel beaches.
Keywords: Boom, manual removal, vacuum trucks, sub-surface oil, blowout, skimmer.

Incident Summary:

On the morning of October 2, 1980, exploratory well No. 6, being drilled by the rig *Ron Tappmeyer* in the Hasbah oil field, blew out. Crude oil began to discharge into the Gulf of Arabia. The hazard caused by the *release of hydrogen sulfide gas* delayed efforts to control the blowout. The well discharged oil until October 10 when it was capped.

Behavior of Oil:

The Iranian crude oil had an API gravity of 19 when fresh, and an API of 10 when weathered. By October 25, a slick covered 3,000 square miles of the Arabian Sea. The slick ranged in density and composition from light sheen to thick, weathered oil. On October 29, oil impacted 50 miles of shoreline to the north of Qatar. By November 9 three quarters of Qatar's coast was oiled. Oil entered Bahrainian waters on October 19 when a reef 15 miles north of the coast was oiled. From October 29 to November 30 oil came ashore along the northern and eastern shores of Bahrain. Throughout November the slick remained offshore of the United Arab Emirates (U.A.E), but only oiled a small portion of the U.A.E. westernmost shoreline.

Countermeasures and Mitigation:

Saudi Arabia, Qatar, Bahrain, and the United Arab Emirates were the four countries threatened by the spill. Response was organized and carried out by various oil companies under the direction of their respective governments.

In Saudi Arabia, the Arabian American Oil Company (ARAMCO), for which the Hasbah 6 was drilled, began conducting overflights on the afternoon of October 2. Overflights continued until the oil moved into Iranian waters

where the Iran-Iraq war precluded any tracking of the oil. This limitation hindered Saudi Arabia's efforts to ascertain the magnitude of the spill.

From October 7 until October 28, *dispersant* was applied to the slick by surface vessels and by helicopter. Smit-Tak was contracted by ARAMCO and arrived on scene October 16 to begin recovery operations. Due to the lack of information about the slick's movement, early dispersant applications were random. As it became evident that the oil would likely impact Qatar and Bahrain, dispersant application was concentrated on the southwest edge of the slick. It is believed that these efforts greatly reduced the severity of the impacts to Qatar and Bahrain.

Bahrainian cleanup operations of a previous spill were concluding when the government was notified of the Hasbah 6 blowout. Spill response in Bahrain was directed by Bahrain Petroleum Company (BAPCO) under orders from the Bahrain government. BAPCO immediately bought additional response equipment. Helicopter overflights by the Bahrain Defense Force and the Bahrain State Police provided accurate information as to the location of the slick. This information allowed for efficient placement of response equipment.

The Bahrain shoreline was affected on October 19 when a reef 15 miles north of the coast was oiled. *Dispersant application* and recovery operations began in that area the next day. Precautionary booms were deployed at recreational areas and other facilities. Tarballs and tarmats that came ashore on October 29 were removed manually. Vacuum trucks were used to collect oil that collected along the edges of breakwaters and jetties.

In Qatar, the Qatar General Petroleum Corporation (QCPC) hired environmental specialists to provide scientific assistance concerning the response operations. Overflights began on October 19. By this time the oil had weathered and was unaffected by dispersants. *Booming of desalinization plant water intakes and power plant water intakes* began with booms obtained from Gulf Area Oil Companies Mutual Aid Organization (GAOCMAO). *Where supplies of boom were short, discarded floating hoses from oil loading systems were used for precautionary booming of intake areas.* It was reported that the hoses worked very well in this capacity.

Approximately 15,000 barrels of oil and water emulsion were recovered by skimming operations. Cleanup of beaches began on October 30, 1980, and continued until March 1981. *Vehicles with rubber tires lost traction* while trying to remove the oil from water. Tracked bulldozers had to be used to push the oil out of the water and onto the beach where rubber tired vehicles loaded and removed the oil.

The United Arab Emirates initiated surveys on October 7 to establish priorities for protection and cleanup. Overflights were conducted to track the slick. Response equipment was placed at strategic locations, and precautionary booming was done at important water intakes. The response ended on November 29 with no severe impacts to the U.A.E. coast.

Other Special Interest Issues:

Because of the extreme density and viscosity of the oil, dispersants would often not penetrate the thicker portions of the slick, and were therefore ineffective. Helicopter crews began to apply undiluted dispersant to the thicker areas. This method achieved some success where diluted dispersant application did not. Dead fish were observed in areas off Qatar where dispersants had been applied.

Attempts were made to sink some of the heavier patches of oil with sand, but these failed. *The oil was observed to be neutrally buoyant, and divers reported that the oil was suspended several yards below the water surface.*

References:

- Hooke, N. Modern Shipping Disasters 1963-1987. Lloyds of London Press. 1987.
- IFP. PLATFORM DATABANK On Accidents to Drilling Vessels or Offshore Platforms (1955-1989).
- Lehr, W.J. and Belen, M.S. 1983. The Fate of Two Large Oil Spills in the Arabian Gulf. Oil Spill Conference Proceedings, 1983, pp. 377-380
- National Research Council. 1989. Using Oil Spill Dispersants on the Sea. National Academy Press, Washington, D.C. p.320.
- Ryan, P.B. 1983. Hasbah 6: Oil Companies Response to Oil Pollution in the Arabian Gulf. Oil Spill Conference Proceedings, 1983, pp. 371-375.
- van Oudenhoven, J.A.C.M. 1983. The Hasbah 6 (Saudi Arabia) Blowout: The Effects of an International Oil Spill as Experienced in Qatar. Oil Spill Conference Proceedings, 1983, pp. 381-388.

Name of Spill: *Haven*
Date of Spill (mmddyy): 4/11/91
Location of Spill: Genoa, Italy
Latitude: 44 20 N
Longitude: 009 00 E
Oil Product: Iranian heavy crude
Oil Type: Type 3
Barrels: 142,857
Source of Spill: Tank Vessel
Resources at Risk: Recreational beaches, fish hatcheries, marinas.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Unusual or experimental cleanup techniques.
Shoreline Types Impacted: Fine sand beaches, coarse sand beaches.
Keywords: International Tanker Owners Pollution Federation (ITOPF), volunteers, remotely operated vehicle (ROV), sub-surface oil, boom, containment boom, skimmers, suction operations, vacuum trucks, manual removal, preventative booming, fire, explosion, sinking.

Incident Summary:

On April 11, 1991, the tanker *Haven* caught fire while anchored 7 miles off of Genoa, Italy. The *Haven* suffered a series of explosions and broke into three parts. A portion of the deck sank, and the rest of the vessel began to drift to the southwest. The bow section sank in water 7 miles off Arenzano. The rest of the vessel was towed to shallower waters 1.5 miles off Arenzano where it sank on April 14.

Behavior of Oil:

Iranian Heavy crude oil has an API gravity of 31, and a pour point of -5 degrees F. Of the 1,000,000 barrels onboard the *Haven* when it caught fire, approximately 450,000 barrels burned. It was estimated that 142,857 barrels spilled into the sea before the *Haven* sank, and small quantities of oil continued to leak from the wreck afterwards. On April 17, oil impacted the beaches at Arenzano, Cogoleto, and Varazze. About 300 barrels of oil entered the marina at Arenzano. Fishing boats, yachts, moorings, and the harbor walls were heavily oiled. The marina at Varazze was also oiled to a lesser degree. Twenty-five miles of Italian coastline were impacted by 1,400 barrels of oil.

By April 24, there was a 154 square mile slick off the coast of France. Mousse and sheen impacted the French shoreline near Nice on April 24. Impacts of oil on the shorelines of France and Monaco were light. St. Tropez suffered the worst damage in France, with about 700 barrels in the form of mousse impacting 3 miles of shoreline.

Countermeasures and Mitigation:

The Harbor Master in Genoa was responsible for the cleanup and recovery of the oil. International Tanker Owners Pollution Federation, Ltd. (ITOPF) personnel arrived on scene the day of the spill to advise the Harbor Master, and to monitor the operations.

The Italian Coast Guard maintained booms in the vicinity of the wreck, and attempted recovery of the oil with skimmers. Ecolmare was contracted for containment and recovery operations. Approximately 35,700 barrels of oil were recovered by April 16.

Booms were deployed as a precautionary measure at recreational beaches. The booms held some slicks offshore, but storms eventually blew the booms and the oil onto the beaches. At Arenzano, Cogoleto, and Varazze, the oil settled 1-2 inches into the fine sand beaches, and up to 1 foot into the coarse grained beaches. Shoreline cleanup was conducted by authorities local to the oiled areas. Cleanup was done by volunteers and the army, and consisted mostly of manual removal of oil and oiled debris. Vacuum trucks were used to pick up the larger pools of oil. Approximately 26,140 cubic yards of oiled debris were collected.

The French Navy attempted to prevent shoreline impacts with booms and skimmers. Shoreline cleanup operations in France and Monaco consisted mostly of manual removal of oil and oiled debris from the beaches.

Other Special Interest Issues:

Surveys using side-scanning sonar, subbottom profiling, and remotely operated vehicles located areas under the track of the vessel where oil had sunk. Diving operations were attempted to recover some of the sunken oil.

Suction operations cleaned burned oil residue from the main wreck, and divers managed to control some of the underwater leaks.

References:

- Genwest Systems, Inc. communications with ITOPF representatives.
- International Oil Pollution Compensation Fund Annual Report 1991. pp.58-70.
- Italian Spill Hits French Riviera, Oil Continues to Leak from Tanker. Oil Spill Intelligence Report. Vol. XIV, No. 15. April 25, 1991. p.2.
- Officials Fear Italian Spill May Impact French Riviera. Oil Spill Intelligence Report. Vol. XIV, No. 14. April 18, 1991. pp.1-2.
- Winds Prevent Further Damage to French Riviera. Oil Spill Intelligence Report. Vol. XIV, No. 16. May 2, 1991. pp.3-4.

Name of Spill: *Howard Star*
Date of Spill (mmddyy): 10/5/78
Location of Spill: Tampa Bay, Florida
Latitude: 27 51 N
Longitude: 082 25 W
Oil Product: Bunker C, Light diesel
Oil Type: Type 4, Type 2
Barrels: 952
Source of Spill: Non-Tank Vessel
Resources at Risk: Diving coastal birds, power plant water intakes, crabs, mangroves.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Closure of shipping lanes or vehicle traffic routes, wildlife impacts, habitat impact due to oil, research conducted, effects to recreational areas.
Shoreline Types Impacted: Mangroves, exposed rocky shores, riprap, sand/gravel beaches, vegetated low banks, tidal mudflat.
Keywords: Boom, vacuum truck, manual removal, sorbents, skimmer, low-pressure washing, disposal, fingerprinting, Gulf Strike Team (GST), Regional Response Team.

Incident Summary:

Sometime between October 4 and 5, 1978, the dry bulk carrier *Howard Star* discharged approximately 952 barrels of bunker C and light diesel into the Port Sutton Channel. The incident most likely occurred while the vessel was deballasting at the International Mineral and Chemical Corporation (IMC) Phosphate Terminal in Tampa, Florida. The oil spread to East Bay, Tampa Bay and Hillsborough Bay and impacted 15 widely separated shorelines over a distance of approximately 20 miles.

Personnel aboard the *Howard Star* failed to notify authorities of the discharge. The Coast Guard Marine Safety Office (MSO) Tampa was first notified by IMC on October 4 at 2025 that approximately 15 gallons of oil was in the water at the IMC terminal. The Coast Guard discovered large quantities of floating oil streaming into Hillsborough Bay from the Port Sutton canal. The Environmental Coastal Pollution Cleanup Service (ECPCS) was notified of the spill and began mobilizing all available boom and cleanup equipment on October 5. An additional cleanup contractor, Need-A-Diver, was contracted by the Coast Guard. The Regional Response Team (RRT) was activated at 1115 on October 5, and the USCG Gulf Strike Team was requested.

Because the entire transit system was affected, the port was closed to help contain the oil. The MSO and cleanup contractors deployed four sections of boom to prevent the oil from spreading further into the surrounding bays. By October 9, approximately 643 barrels of oil had been recovered by the contractors and the Coast Guard. Since the populations of migratory waterfowl are low in October, there were only 14 known bird fatalities. Several dead crabs were found along Whiskey Key and E.G. Simmons Park, but the population appeared to recover within 60 days of the incident. Several mangrove trees died as a result of the oiling.

Behavior of Oil:

Bunker C fuel oil is a heavy product with an API gravity that ranges from 7 to 14. Light diesel is a refined, light weight material with an API gravity of about 40. The oil was first spotted while it was streaming out of the Port Sutton canal into Hillsborough Bay. By October 5, the oil extended southwesterly from Port Sutton to within 0.5 miles of MacDill Air Force Base (AFB) on the Interbay Peninsula. On October 6, Coast Guard personnel discovered approximately 119 barrels of oil on the MacDill AFB shoreline. A large pocket of oil was also observed at the crash boat pier. Observations during an overflight revealed two heavy slicks off the eastern coast of MacDill AFB.

On October 7, personnel at the Tampa Electric Company (TECO) at Big Bend reported approximately 36 barrels of oil trapped at their thermal dilution pump intakes. Oil came ashore at the E.G. Simmons Park swimming, camping, and picnicking area on the eastern side of Hillsborough Bay. Oil covering a 2 to 6 foot wide area from 1 to 4 inches thick was trapped along the beaches on the south side of the peninsula across from the Big Bend Terminal to Whiskey Key. Approximately 24 barrels of oil were trapped in a cove located across from Whiskey Key.

On October 9, oil extended into the Gulf of Mexico from the Mullet Key Channel. An October 10 Coast Guard overflight identified large quantities of oil in a large drainage ditch and swamp north of the drive gate at MacDill AFB. On October 17, approximately 1,000 gallons of oil were discovered covering the northern shoreline of Paradise Island. Following the removal of 80% of the oil, strong northeasterly winds drove most of the remaining oil into a small cove on the northern shore and saturated the sand to a depth of almost 6 inches.

Countermeasures and Mitigation:

On October 5, twenty-four hundred feet of *containment boom* were deployed from Pendola Point into Hillsborough Bay to contain the oil on the south shore of Port Sutton. Oil trapped at the Seaboard Coast Line Rockport Terminal in East Bay was contained by 2,000 feet of boom placed along the north shore of Port Sutton. An additional 2,000 feet of boom deployed across the 22nd Street Causeway protected the McKay Bay entrance. Four thousand feet of boom were placed at the Eastern Associated Terminal to trap oil on the west shore. Oil Mop Inc. (OMI) personnel boomed off the intake valves at the TECO plant. Two Coast Guard personnel placed boom at E.G. Simmons Park by swimming across the mangrove-lined canals.

Vacuum trucks and barges, assisted the cleanup of trapped oil between the Seaboard Coast Line Rockport Terminal and the Eastern Associated Terminal. The south shores of Port Sutton and Pendola Point were cleaned manually by workers using rakes, shovels, and *sorbents*. Sorbents materials were also used to cleanup oil that entered the Ballast Point yacht basin. Vacuum trucks were used to remove the oil trapped at the MacDill AFB drainage ditch. Further cleanup in this area was limited due to soft mud banks and bottom that prohibited the movement and use of heavy equipment.

A U.S. Navy *skimmer* collected oil that was not contained by boom in an effort to reopen the port to vessel traffic. The two oil slicks along the eastern shore of MacDill AFB were skimmed as well. The CG-32303 waterside pollution patrol boat proved invaluable in assisting the skimmers. *The fire monitor aboard the boat was used to direct oil towards the skimmers and flush trapped oil from under the crash boat pier.*

Front-end loaders provided by the State of Florida were used to remove the narrow strips of oil soaked sand at Whiskey Key and Apollo Beach. Raking was effective in collecting oil-soaked shells, seaweed, dry leaves, and sand for removal by front-end loaders and dump trucks. *Low-pressure washing* with Air Force fire station water pumps cleaned shores near the MacDill AFB crash boat dock. Boom was placed across the mouth of a nearby ditch to catch residual oil as tidal movements flushed the oil from among the mangrove roots.

Polyurethane sheeting was used to cover picnic tables, shoreline, and grass during cleanup at E.G. Simmons Park. The oil-covered grassy banks and mangrove roots were washed using *low-pressure pumps* on the recommendation of the Environmental Protection Agency (EPA). The oil streaming out with the wash water was trapped by booms and recovered using sorbents.

Solid waste was removed to Taylor Road, Hillsborough County, Solid Waste Control Utilities Operations Department in Tampa, Florida for disposal. Recovered liquid oil went to International Petroleum Corporation and National Oil Service for disposal.

Other Special Interest Issues:

The Coast Guard collected oil samples from several vessels and terminals in the area in the effort to identify the source of the spill. Nineteen samples were taken at each cleanup site for comparative analysis. Using two chromatography techniques and two types of spectroscopy, the Coast Guard Central Oil Identification Laboratory in Groton, Connecticut, determined the oil from the settling tanks of the *Howard Star* to be the same oil that was collected at the cleanup sites. Analysis of weather, current patterns, and photographs of the vessel moored at the IMC Terminal confirmed that the *Howard Star* was the source of the spill. Had the responsible party notified the Coast Guard at the time of the incident, containment of the oil within Port Sutton channel would have been relatively simple, and would have resulted in far less expense and environmental impact.

Mangrove Systems, Inc. (MSI), conducted a study to assess the extent of ecological damage caused by the incident. MSI studied 25 oiled mangrove trees from three separate species, including *Avicennia germinans*, *Laguncularia racemosa*, and *Rhizophora mangle*, as well as 25 control mangrove trees at eight sampling stations. The stations were visited monthly between October 1978 and August 1980. During this time, only one oiled mangrove tree died and two showed signs of stress (root death, partial defoliation, yellow leaves, etc.). From this study, Mangrove Systems, Inc., concluded that approximately 1.2 acres of mangrove trees died as a result of the oiling. Younger mangrove trees, less than 3 feet tall and between 1-3 months old, died first while the older trees took up to a year to show signs of stress and/or death.

References:

- Lewis, R.R. 1980. The Impact of the Howard Star Oil Spill on Marine Communities in Tampa Bay, Florida. Mangrove Systems, Inc., Tampa, Florida. pp. 40.
- U.S. Coast Guard On-Scene Coordinator's Report

Name of Spill: *Independenta*
Date of Spill (mmddyy): 11/15/79
Location of Spill: Istanbul, Turkey
Latitude: 41 02 N
Longitude: 028 57 E
Oil Product: Es Sider Crude Oil
Oil Type: Type 2
Barrels: 687,785
Source of Spill: Tank Vessel
Resources at Risk: Recreational beaches, intertidal and subtidal mining leases, commercial fisheries.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Adverse weather conditions, closure of shipping lanes or vehicle traffic routes.
Shoreline Types Impacted: Exposed seawalls, piers.
Keywords: Booms, International Tanker Owners Pollution Federation (ITOPF), collision, explosion, fire.

Incident Summary:

On the morning of November 15, 1979, the *Independenta* and the *Evrialy* collided at the southern entrance of the Bosphorus. The *Independenta* exploded and both vessels began to burn. The *Independenta* grounded a half of a mile from the port of Hydrapasa. The tanker burned until December 14. The *Independenta* was carrying 714,760 barrels of Es Sider crude oil.

Behavior of Oil:

Es Sider crude oil has an API gravity of 36.7, and a pour point of 30 degrees F. Little oil was found on the water, and it was surmised that the majority of the oil had burned on the tanker. Any slicks of oil probably drifted into the Sea of Marmara and dissipated. From November 17 to November 27, there was slight leakage from the vessel. The vessel suffered another major explosion on December 6, resulting in more oil spilled. The slick from the vessel drifted towards the port of Hydrapasa, and despite booms across its entrance, approximately 380 barrels of oil entered the harbor.

Countermeasures and Mitigation:

The Turkish Navy attempted to extinguish the fire early in the incident, but the intensity of the fire caused these efforts to be abandoned. The Director of the Marmara Sea District took over the spill on November 19, and the Navy withdrew.

International Tanker Owners Pollution Federation Ltd. (ITOPF) personnel came on scene on November 17. The Turkish government refused permission for overflights, and all pollution surveys were conducted by boat. Little pollution was found and the ITOPF personnel left on November 27.

Explosions onboard the vessel on the night of December 6, prompted the return of ITOPF personnel on December 10. Surveys after the fire had extinguished itself revealed that there was no further leakage from the vessel. Approximately 15,240 barrels of oil were left on the vessel. It was surmised that the majority of the oil on the tanker had burned.

The owner of the tanker arranged for boom and skimmers to be flown in from the United Kingdom. After the explosion on December 6, a slick was observed drifting towards the port of Hydrapasa, and boom was deployed across its entrance. The rest of the equipment, including five skimmers, was never used.

Surveys showed that little of the spilled oil impacted the shoreline. The southeast shore of the Bosphorus was the most heavily oiled area. There was no reported cleanup of oiled shorelines.

Other Special Interest Issues:

Strong prevailing winds during the leakage of oil from the December 6 explosion prevented the boom across the port of Hydrapasa from being more effective.

The sides of the Bosphorus are heavily built up. There are many recreational beaches at the southern entrance to the Bosphorus, and in the Sea of Marmara. The largest concern was for the shorelines of Kalolimno and Marmara Islands. They are the source of important beach sand (used for construction) and marble industries.

There were no reports of adverse effects to the local fishing industry, as neither a major fish migration nor the fishing season were in progress at the time.

References:

- 8/9/91 & 8/28/91 Letters from Daniel Owen at ITOPF.
- Genwest Systems, Inc. communications with ITOPF representatives.
- Hooke, N. Modern Shipping Disasters 1963-1987. Lloyds of London Press. 1987.
- MMS Worldwide Tanker Spill Database.
- Oil Spill Intelligence Report. 2/21/91.
- Oil Spill Intelligence Report. Oil Spills, International Summary & Review, 1978-1981.
- Tanker Advisory Center, Inc. 1991 Guide for the Selection of Tankers. T.A.C. Inc. 1991.

Name of Spill: *Irene's Challenge*
Date of Spill (mmddyy): 01/17/77
Location of Spill: Pacific Ocean, 50 miles north of the Hawaiian Islands
Latitude: 26 53 N
Longitude: 173 52 W
Oil Product: Light crude oil
Oil Type: Type 2
Barrels: 237,600
Source of Spill: Tank Vessel
Resources at Risk: Wildlife preserves, seals, petrels, gulls, terns.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Logistical or operational problems.
Shoreline Types Impacted: None
Keywords: Sub-surface oil, sinking, Regional Response Team.

Incident Summary: On January 17, 1977, the 640-foot tank vessel *Irene's Challenge* broke into two pieces approximately 200 miles south of Midway Island and 50 miles north of Lisianski Island, Hawaii. The deck plates of the vessel failed due to the stress incurred by several days of rough seas. Twenty-eight of the thirty-one crewmen were picked up by the *Pacific Arrow*. The three remaining crew members were not found.

The Regional Response Team (RRT) and Science Advisory Group (SAG) agreed that the best option in dealing with the damaged vessel was to attempt to tow the two sections away from the Hawaiian islands, and sink them. The U.S. Coast Guard cutters *Mallow* and *Jarvis* were diverted to the scene for towing operations. The sections were approximately 70 miles apart when the two cutters arrived at the stern section. Since crew members were unable to board or tow the stern section due to rough seas, the *Mallow* continued on toward the bow section. The stern section of the tanker presumably sank at approximately 26 55 N and 172 30 W. By January 21, the bow section had only 25 feet of freeboard. Visual observations estimated the sinking bow section was settling at a rate of 20 inches per hour. The bow section sank of its own accord. The two cutters remained on-scene until January 22 to observe oil conditions.

Behavior of Oil:

Personnel on an early morning overflight on January 18 reported the slick to be 2 miles long. Participants on a later C-130 overflight reported the slick to be 4-5 miles in length and drifting to the west. On January 19, leaking oil had created a slick 15 by 17 nautical miles which was drifting to the east, away from the Hawaiian Islands. Oil storage tanks in the bow section appeared to be intact until the bow sank. Oil released from the stern section on January 20 was not as heavy as observed earlier, and was dissipating rapidly.

Although the spill area was surrounded by three ecologically important wildlife refuges, favorable southwest winds prevented any shoreline oiling. On January 21 a 20 mile by 5 mile slick was observed near the position of the sunken stern. North of the main slick, a lighter, triangular shaped slick extended to the west. Seabirds were spotted between, but not within the two oil slicks.

No residual oil was observed surfacing after January 22. The slick was dissipating rapidly from wind and wave action. The vessel sank in 2700 fathoms of water. At this depth, the oil was presumed to have congealed due to the low temperature (1-2°C). Any oil released from the sunken sections was expected to disperse before reaching the surface. By January 27, the oil slick consisted of light streaks covering a 4 mile by 1/2 mile area.

Countermeasures and Mitigation:

Since the two sections sank quickly, a towing operation was not attempted. Questions were raised concerning the feasibility of towing the partially submerged sections of the vessel. The resulting slick and surfacing oil was observed and tracked by the Coast Guard for ten days. *Dispersant* use was recommended in the event of any oil impacting the shoreline. The natural dispersion of the oil by wave action negated dispersant use.

High Seas Oil Containment Barrier was transported from San Francisco to Honolulu for possible deployment on USCG Cutter *Buttonwood*, but was not used.

Other Special Interest Issues:

The incident occurred 57 miles from U.S. coastline, which is outside the area of U.S. jurisdiction for action and reimbursement. Due to the location of the incident, the *Intervention on the High Seas Act* (33 USC 1471 et seq) was required. Section 1472 of this act allows the use of action when interests of the U.S. are threatened by pollution. Funding of the response was available through Section 1486 of the same act.

References:

- 8/9/91 & 8/28/91 Letters from Daniel Owen at ITOPF
- Hooke, N. Modern Shipping Disasters 1963-1987. Lloyds of London Press. 1987.
- MMS Worldwide Tanker Spill Database
- Tanker Advisory Center, Inc. 1991. .Guide for the Selection of Tankers. T.A.C. Inc. 1991.
- USCG Federal On-Scene Coordinator's Report

Name of Spill: IXTOC I
Date of Spill (mmddyy): 06/03/79 to 03/23/80
Location of Spill: Bahia de Campeche, Mexico
Latitude: 19 24.5 N
Longitude: 092 19.5 W
Oil Product: IXTOC I crude oil
Oil Type: Type 3
Barrels: 3,522,400
Source of Spill: Platform
Resources at Risk: Shrimp, shorebirds, wading birds, beaches, marinas.
Dispersants: Yes
Bioremediation: No
In-situ Burning: Yes
Other Special Interest: Research conducted, habitat impact due to oil, wildlife impacts, interaction with foreign or Native authorities, effects to tourism.
Shoreline Types Impacted: Marshes, mangroves, exposed fine sand beaches, sheltered fine-grained sand beaches, eroding bluffs, mixed sand and shell beaches, exposed tidal flats (low biomass), exposed tidal flats, sheltered tidal flats.
Keywords: Boom, Corexit 9527, skimmer, manual removal, volunteers, blowout, fire, evaporation, blowout preventer, relief well, submersible.

Incident Summary:

On June 3, 1979, the 2 mile deep exploratory well, IXTOC I, blew out in the Bahia de Campeche, 600 miles south of Texas in the Gulf of Mexico. The IXTOC I was being drilled by the SEDCO 135, a semi-submersible platform on lease to Petroleos Mexicanos (PEMEX). A loss of drilling mud circulation caused the blowout to occur. The *oil and gas blowing out of the well ignited*, causing the platform to catch fire. The burning platform collapsed into the wellhead area hindering any immediate attempts to control the blowout.

PEMEX hired blowout control experts and other spill control experts including Red Adair, Martech International of Houston, and the Mexican diving company, Daivaz. The Martech response included 50 personnel on site, the remotely operated vehicle TREC, and the submersible Pioneer I. The TREC attempted to find a safe approach to the Blowout Preventer (BOP). The approach was complicated by poor visibility and debris on the seafloor including derrick wreckage and 3000 meters of drilling pipe. Divers were eventually able to reach and activate the BOP, but the pressure of the oil and gas caused the valves to begin rupturing. The BOP was reopened to prevent destroying it. *Two relief wells were drilled* to relieve pressure from the well to allow response personnel to cap it. Norwegian experts were contracted to bring in skimming equipment and containment booms, and to begin cleanup of the spilled oil. The IXTOC I well continued to spill oil at a rate of 10,000 - 30,000 barrels per day until it was finally *capped on March 23, 1980*.

Behavior of Oil:

Prevailing northerly currents in the western Gulf of Mexico carried spilled oil toward the U.S. A 60-mile by 70-mile patch of sheen containing a 300 foot by 500 foot patch of heavy crude moved toward the Texas coast. On August 6, 1979, tarballs from the spill impacted a 17 mile stretch of Texas beach. Mousse patches impacted the shoreline north of Port Mansfield Channel on August 15 and again on August 18. On August 24, mousse impacted shoreline south of Aransas Pass. By August 26, most of North Padre Island was covered with moderate amounts of oil.

As of September 1, all of the south Texas coast had been impacted by oil. A storm lasting from September 13-15 removed the majority of the oil. For the remainder of the response and subsequent study period (through August 1980) only tarmats were observed on the beaches. Some oil escaped around boom barriers protecting the three major inlets. During the September storm, there was washing of oil over the Barrier Islands. Impacts to the estuaries were minor.

Countermeasures and Mitigation:

In the initial stages of the spill, an estimated *30,000 barrels of oil per day* were flowing from the well. In July 1979 the pumping of mud into the well reduced the flow to 20,000 barrels per day, and early in August the pumping of nearly 100,000 steel, iron, and lead balls into the well reduced the flow to 10,000 barrels per day. Mexican authorities also drilled two relief wells into the main well to lower the pressure of the blowout. *PEMEX claimed that half of the released oil burned when it reached the surface, a third of it evaporated, and the rest was contained or dispersed.*

PEMEX contracted Conair Aviation to spray the chemical dispersant *Corexit 9527* on the oil. A total of 493 aerial missions were flown, treating 1,100 square miles of oil slick. *Dispersants were not used in the U.S. area of the spill* because of the dispersant's inability to treat weathered oil. Eventually the OSC requested that Mexico stop using dispersants north of 25°N.

In Texas, an emphasis was placed on coastal countermeasures protecting the bays and lagoons formed by the Barrier Islands. Impacts of oil to the Barrier Island beaches were ranked as second in importance to protecting inlets to the bays and lagoons. This was done with the placement of skimmers and booms. Efforts were concentrated on the Brazos-Santiago Pass, Port Mansfield Channel, Aransas Pass, and Cedar Bayou (which during the course of the spill was sealed with sand). Economically and environmentally sensitive barrier island beaches were cleaned daily. Laborers used *rakes and shovels* to clean beaches rather than heavier equipment which removed too much sand. Ultimately, 71,500 barrels of oil impacted 162 miles of U.S. beaches, and over 10,000 cubic yards of oiled material were removed.

On August 8, the United States Fish and Wildlife Service (FWS) began training volunteers for the handling of oiled birds and implemented beach patrols on South Padre Island. *Bird cleaning stations* were set up by the FWS on Mustang and South Padre Islands. An overall decrease in bird population densities due to movement from their regular habitats along the oiled shoreline may account for the fact that only a few dead, oiled birds were ever found. After the beaches were cleaned, population densities increased, but not to expected levels. Contamination of food supplies caused many birds to leave their habitats for the duration of the spill. One thousand four hundred twenty one birds were recovered with oiled feathers or feet. The species suffering the most incidents of oiling were the Royal Terns, Blue-faced Boobies, Sanderlings, Willets, Piping Plovers, Black-bellied Plovers, and Snowy Plovers suffered oiling to their feathers while Great Blue Herons, Black-Crowned Night Herons, Noddy Terns, Cattle Egrets and Snowy Egrets had tarred feet.

Other Special Interest Issues:

The U.S. government had *two months to prepare* for the expected impact of the IXTOC I oil on the Texas shoreline. During this time the government realized the importance of *coastline mapping* in regards to oil sensitivity. This led to a mapping project which resulted in the first Environmental Sensitivity Index (ESI) prepared by Research Planning, Inc. (RPI) under contract to the National Oceanic and Atmospheric Administration (NOAA). Placement of containment boom and other response equipment was done after study of the environmental sensitivity as reported in the ESI.

The IXTOC I well blowout was an unusual situation with regard to responsibility for, coordination of, and control and cleanup of the spilled oil. The U.S. government publicly requested *compensation from Mexico* for damages associated with the spill without first entering into negotiations with the Mexican Government. Mexico denied being financially responsible for damages incurred, and refused to help pay cleanup expenses to the U.S.

Officials reported that *tourism* along the Texas beaches dropped by 60% during the course of the spill.

References:

- Chapman, B. 1981. Effects of the IXTOC I Oil Spill on Texas Shorebird Population., Oil Spill Conference Proceedings, 1981, pp. 461-465.
- Emery, B., Lara, M., and Lindblom, G. 1981. Aerial Application of Dispersants at the IXTOC I Spill., Oil Spill Conference Proceedings, 1981, pp.259-262
- Gundlach, E., Finkelstein, K., and Sadd, J. 1981. Impact and Persistence of IXTOC I Oil on the South Texas Coast, Oil Spill Conference Proceedings, 1981, pp. 477-485.
- Mexico Refuses to Pay Damages in Oil Spill. The Seattle Times. August 24, 1979.
- NOAA Special Report
- Pemex Claims 1 IXTOC oil flow cut to 10,000 barrels per day. Oil & Gas Journal. August 20, 1979. p. 62.
- Pemex Says IXTOC Wells Set Drilling Speed Record. Oil & Gas Journal. September 17, 1979. p. 49.
- Research Ships to Aid Oil Slick Fight off Texas. Oil & Gas Journal. August 27, 1979. p. 41.
- Texas Oil Cleanup Aimed at Labor Day. The Seattle Times. August 26, 1979.
- U.S. Seeks 'amicable' Cleanup Settlement. The Seattle Times. August 25, 1979. p.A5.
- Uncontrolled Mexican Blowout Will Require Relief Well. Sea Technology. August 1979.
- USCG Federal On-Scene Coordinator Interim Activities Report
- USCG On-Scene Coordinator's Final Report

Name of Spill: *Jupiter*
Date of Spill (mmddyy): 09/16/90
Location of Spill: Saginaw River, Bay City, Michigan
Latitude: 43 30 N
Longitude: 084 00 W
Oil Product: Unleaded gasoline
Oil Type: Type 1
Barrels: 20,000
Source of Spill: Tank Vessel
Resources at Risk: Fish, raptors, rookeries, migration stopover area, waterfowl, drinking water intakes.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Closure of shipping lanes or vehicle traffic routes. complex salvage operations.
Shoreline Types Impacted: None
Keywords: Boom, vacuum truck, fire, manual removal, explosion, lightering, disposal.

Incident Summary:

At 0845 on September 16, 1990, the tank vessel *Jupiter* caught fire and exploded during offloading operations at the Total Oil Company refinery on the Saginaw river near Bay City, Michigan. A wake from a passing bulk carrier apparently caused the parting of the *Jupiter's* transfer hose, grounding cable, and all but one of its mooring lines. Residual gasoline in the broken transfer hose was believed to have been ignited by a spark on the dock. The *Jupiter's* stern swung around into the Saginaw River and grounded perpendicular to the direction of the river flow. The grounding resulted in a crack in the vessel's hull from the manifold on the starboard side to 75 feet aft of the manifold on the port side.

Area marinas were evacuated and vessel traffic was halted. Bangor County Fire Department and USCG personnel arrived on-scene within 30 minutes of the incident. The pier fire was extinguished in an attempt to save the last mooring line while the fire onboard the vessel remained out of control. Williams Boots & Coots Company (WB&C) from Houston, Texas, was contracted to fight the fire due to the lack of locally available trained personnel and equipment. At 1315 on September 17, WB&C personnel extinguished the blaze by applying foam. Carbon black accumulations falling from the overhead re-ignited the fire at 2300. This second blaze was cooled with water and extinguished with foam on September 18. WB&C personnel also applied foam inside the vessel's cargo tanks to prevent re-ignition of the vessel.

River flow data were obtained from the Army Corps of Engineers to predict the oil movement. Shock waves from the explosion may have contributed to the deaths of several fish that were recovered from around the vessel.

Neither pollution nor shoreline contamination was observed during the final survey of the area on October 22.

Behavior of Oil:

Automotive gasoline is a very light weight, refined product with an API gravity of 60 to 63. No spill of product into the Saginaw River was reported until first light on September 17 when fuel up to three inches thick was observed in the water immediately surrounding the vessel. Some of the spilled product was held against the hull of the vessel by the wind until the starboard side submerged, releasing an additional 100 barrels of the fuel. *Since the gasoline was not released rapidly, little environmental damage resulted from the incident.*

Countermeasures and Mitigation:

On September 16, *containment boom* was deployed around the vessel as a precaution against further spillage. The boom remained in place until the vessel was re-floated on October 16 and moved to the north side of the river. No product was observed leaking from the vessel as it was relocated.

Vacuum trucks were used to recover the gasoline and water mixture. Approximately 262 barrels were recovered by September 28. Small amounts of carbon residue that impacted the shoreline were manually raked from beaches in the area.

On September 19, gasoline odors were reported in the sewers of a residential community near the incident site. Contractors were dispatched to flush and foam the sewers. Sections of *boom* and a *combustible gas detector* were set up to monitor the sewer outfall.

On September 27, approximately 770 barrels of product were offloaded from the *Jupiter* to a lightering barge. Gas freeing operations began on October 5, due to the explosion threat posed by some isolated pockets of product remaining in the #6 starboard cargo tank. Offloaded product was replaced with water to reduce the structural stress to the damaged vessel.

Since trace concentrations of benzene, toluene, ethyl benzene, and xylene isomers were found in water samples near the *Jupiter*, water at a nearby *water treatment plant* was treated with ozone as a precaution.

Other Special Interest Issues:

The fire fighting foam (AFFF) that was used on the fire was water soluble and moderately toxic. Contaminated water from the fire fighting operation was collected and brought to a Bay City Wastewater Plant retention basin for special treatment. The treatment involved removal of particulates followed by carbon filtration to remove organic constituents.

References:

- MMS Worldwide Tanker Spill Database.
- Oil Spill Intelligence Report. International Spill Statistics 1989-1990, Special Report, 3/28/91.
- Oil Spill Intelligence Report. Oil Spills, International Summary & Review, 1989-1990.
- U.S. Coast Guard POLREP file.
- World Information Systems. 1991. Tanker Losses in U.S. Waters: 1978-1990. World Information Systems.

Name of Spill: *Khark 5*
Date of Spill (mmddyy): 12/19/89
Location of Spill: 400 miles north of Las Palmas, Canary Islands
Latitude: 34 32 N
Longitude: 099 34 W
Oil Product: Iranian Heavy crude oil
Oil Type: Type 4
Barrels: 452,400
Source of Spill: Tank Vessel
Resources at Risk: Migratory stopover area, high-use recreational fishing area, commercial fisheries, oysters.
Dispersants: Yes
Bioremediation: No
In-situ Burning: No
Other Special Interest:
Shoreline Types Impacted: Sand/gravel beaches.
Keywords: International Tanker Owners Pollution Federation (ITOPF), Atlantic Strike Team (AST), manual removal, fire, explosion, evaporation, Side Looking Airborne Radar (SLAR), Infra Red (IR), Finasol OSR-2.

Incident Summary:

On December 19, 1989, the Iranian tanker *Khark 5* bound for refineries in Northern Europe exploded and caught fire approximately 400 miles north of the Canary Islands. An estimated 452,400 barrels (19 million gallons) of the 1,714,300 barrels (72 million gallons) on board spilled into the sea. The 35 crew members were rescued by the passing Soviet vessel *Sarny*.

Ocean currents carried the abandoned vessel south towards the Canary Islands. A Moroccan Government Response Task Force consisting of members from the Moroccan Royal Navy, Interior Ministry, Ministry of Fisheries, and the Civil Defense Force responded to the incident. According to a joint Spain/Morocco contingency plan, the Spanish government was prepared to provide aid if necessary. The Moroccan government sent a formal request to the U.S. Coast Guard for technical assistance in evaluating the situation. An Atlantic Strike Team (AST) representative was sent to the scene on January 4, 1990. The International Tanker Owners Pollution Federation (ITOPF) provided cleanup equipment and an on-scene advisor.

Smit Tak, a Dutch salvage company, repaired a 60 foot by 90 foot hole in the vessel's port side. Early efforts to tow the damaged vessel away from the shore were hampered by 8-foot waves and high winds. On January 1, a tug secured a line to the *Khark 5* and began towing the vessel towards the Madeira Islands off Portugal as Morocco and Spain refused to allow the vessel close to their shores. Fourteen aircraft and seven boats were used to spray detergents on the slick.

Behavior of Oil:

Iranian Heavy crude oil has an API gravity of 31, a viscosity of 9.36 centistokes, and a pour point of -5 degrees F. The ITOPF representative flew over the stricken vessel on December 21 and 24 from London and reported oil leaking from the ship at a slow rate. The ITOPF representative conducted daily overflights based from Morocco beginning on December 29. Over the next few days he reported that oil was staying in the same general offshore areas with a southwesterly longshore drift. A large slick from the initial release drifted to within 12 miles coast of Morocco by January 2. On a January 5 overflight, the AST representative observed significant quantities of oil, but widely scattered and mostly sheen with scattered 100 yard by 50 yard patches of mousse. The closest mousse patch was 18 miles offshore while the majority of mousse was 60-70 miles offshore.

The French government used a Side Looking Airborne Radar (SLAR) and infrared (IR) sensor equipped Cessna aircraft on daily overflights. They did not observe oil within 20 miles of the coast. Oil was reported on a 1 kilometer stretch of shoreline south of Casablanca. *An estimated 75 per cent of the spilled oil evaporated, was dissipated by wave action, or was dispersed into the water column.*

Countermeasures and Mitigation:

Approximately 600 meters of *inflatable boom* was placed across the lagoon at Oualidia to protect oysters from the oil. Some of the floating oil was *vacuumed* into oil separators.

Oil on the shoreline south of Casablanca was cleaned using *rakes, shovels,* and *plastic bags* provided by ITOPF.

Approximately 6,600 gallons of *dispersal agents* were applied to the floating oil in the first week of January. Over 1,500 gallons of *Finasol OSR-2*, made from hydrocarbon-based solvents, were applied in two passes by six aircraft with spraying equipment. A tugboat dispatched from Spain applied approximately 5,000 gallons of *A-3 dispersant* closer to shore. These chemical dispersants were relatively ineffective, as they were applied after the oil had weathered.

On January 8, the AST representative recommended that overflights be reduced to one every other day as long as the winds remained from the northeast.

Other Special Interest Issues:

The *Khark 5* may not have been structurally sound since it had been damaged three times in air strikes during the 8-year Iran-Iraq war. The seaworthiness of the *Khark 5* was also questioned because it was underinsured.

Morocco was ill-prepared to deal with the magnitude of this oil spill. News of the incident did not appear in the international press until eleven days after the initial explosion and fire. Much time was lost prior to any response while the Iranian owners and the Dutch salvage company were involved in financial disputes.

References:

- 8/9/91 & 8/28/91 Letters from Daniel Owen at ITOPF.
- Genwest Systems, Inc. communications with ITOPF representatives.
- MMS Worldwide Tanker Spill Database
- OSIR Newsletter 2/21/91
- OSIR Oil Spills, International Summary & Review, 1989-1990
- Tanker Advisory Center, Inc. 1991 Guide for the Selection of Tankers. T.A.C. Inc. 1991.

Name of Spill: *Kirki*
Date of Spill (mmddyy): 07/21/91
Location of Spill: Cervantes, Western Australia
Latitude: 30 38 S
Longitude: 114 41 E
Oil Product: Light Murban crude
Oil Type: Type 2
Barrels: 135,000
Source of Spill: Tank Vessel
Resources at Risk: Lobsters, sea lions, diving coastal birds, waterfowl, commercial fisheries, reserves.
Dispersants: Yes
Bioremediation: No
In-situ Burning: No
Other Special Interest: Complex salvage operations.
Shoreline Types Impacted: Sand/gravel beaches.
Keywords: Lightering, boom, fire, evaporation, Ardox 6120, Shell VTS, salvage.

Incident Summary:

On July 21, 1991, the Greek tanker *Kirki* caught fire 20 miles off the coast of Western Australia, near Cervantes. The vessel was en-route from the Arabian Gulf to Kwinana, Australia. It was owned by Mayamar Marine Enterprises of Piraeus, Greece. The *Kirki's* bow broke off in heavy seas, rupturing two of the forward tanks. Approximately 135,000 barrels of light Murban crude were spilled, most of it on the first day. Small amounts of oil leaked during the subsequent towing of the *Kirki*. The salvage vessel *Lady Kathleen* was in the area of the incident and responded quickly to the *Kirki's* distress call. The *Lady Kathleen* towed the vessel to the west away from the shore, preventing further casualties.

Behavior of Oil:

Light Murban crude oil has an API gravity of 40.5, and a pour point of -24 degrees F. The spill from the broken bow created a 60 mile long, 1 to 10 mile wide slick just 4 miles off the coast of Western Australia. The fire on the *Kirki* was extinguished quickly, so little oil burned. By July 24, most of the spilled oil had evaporated or dissipated in heavy seas. The small amount of oil that leaked during the tow dissipated within a few miles of the vessel's track. On July 23, some beaches around Jurien Bay were polluted by oil in the form of small emulsified pellets.

Countermeasures and Mitigation:

The ruptured tanks on the *Kirki* continued to leak small amounts of oil as the vessel was towed an additional 55 miles west from the shoreline. Recovery and cleanup equipment were flown to the area, but application of dispersants was the primary response. Use of dispersants began on July 22 and ended the next day. *Dispersants (24 drums of Ardox 6120, 6 drums of Shell VTS)* were applied from aircraft to the area of the initial spill. Small amounts of dispersants were sprayed by boat to areas closer to shore.

While the heavy seas prevented use of booms and skimmers in the spill area, booms were deployed as a preventive measure around some of the more sensitive islands in the area. Besides the dispersion due to wave action, the oil was further broken up by five fishing boats that repeatedly traversed the slick.

Beach impacts were slight and the Australian Environmental Protection Authority (EPA) recommended that no action be taken except for some tilling near inhabited areas.

Plans were made to transfer the oil remaining on the stern section of the *Kirki* to another vessel. The *Kirki* was towed to a point 70 miles northwest of the Australian coast by the salvage ship *Lady Elizabeth*. Between August 14 to August 19, 484,000 barrels of light Murban crude, fuel oil, and waste oil, were transferred to the Liberian tanker *Flying Clipper*. Due to the missing bow, the *Kirki* could not be anchored, so the transfer operations were performed while all three vessels involved were underway. By August 22, United Salvage had the *Kirki* undertow en-route to Singapore for salvage or scrapping.

Other Special Interest Issues:

The transfer of oil while all the vessels involved were underway was unusual. The Australian Maritime Safety Authority reported that it was the first time that such an operation was ever performed and it was very successful.

References:

- Australian Officials Conduct Successful Transfer of Oil from Greek Tanker *Kirki*. Oil Spill Intelligence Report. Vol. XIV, No. 32. 22 August 1991. pp.2-3.
- Australian Officials Prepare to Transfer Oil from Greek Tanker *Kirki*. Oil Spill Intelligence Report. Vol. XIV, No. 29. 1 August 1991. p.3.
- Genwest Systems, Inc. communications with ITOPF representatives.
- Greek Tanker Breaks Up off Western Coast of Australia; Authorities Question Ship's Crew and Captain. Oil Spill Intelligence Report. Vol. XIV, No. 28. 25 July 1991. pp.1-2.

Name of Spill: *Kurdistan*

Date of Spill (mmddyy): 03/15/79

Location of Spill: Cabot Strait, Newfoundland

Latitude: 46 00 N

Longitude: 060 00 W

Oil Product: Bunker C

Oil Type: Type 4

Barrels: 43,900

Source of Spill: Tank Vessel

Resources at Risk: Diving coastal birds, alcids, gulls, waterfowl, shorebirds, bird wintering areas, seals, lobster, kelp.

Dispersants: No

Bioremediation: No

In-situ Burning: No

Other Special Interest: Wildlife impacts, adverse weather conditions, logistical or operational problems, research conducted.

Shoreline Types Impacted: Sand/gravel beaches, marshes, coarse gravel beaches, vertical rocky shores.

Keywords: Backhoes, boom, sorbents, manual removal, sub-surface oil, sinking, reoiling, disposal.

Incident Summary:

On March 15, 1979, the British motor tanker *Kurdistan*, en route from Nova Scotia to Quebec, broke in two sections south of Cabot Strait, Newfoundland. The damage was attributed to a fracture initiated by a weld defect and aggravated by wave impacts on the bow at low temperatures. Although the tanker remained intact for some time after the initial hull plate failure, the bow and stern sections eventually separated and spilled an estimated 43,900 barrels of Bunker C into Cabot Strait. The bow and stern sections drifted towards Canadian waters. Approximately 50,000 barrels of oil remained in the bow section while 115,000 barrels remained in the stern.

A wide band of mobile pack ice initially prevented the spilled oil from reaching the shoreline. The Environmental Protection Service (EPS) immediately initiated the formation of the Regional Environmental Emergencies Team (REET) to provide assistance and advice to the Canadian Coast Guard's (CCG) On-Scene Commander (OSC). REET members included the Atmospheric Environment Service, Bedford Institute of Oceanography, and Fisheries Management Service. The REET was divided into three sections to deal with the three distinct problems: the bow, the stern, and the oil spill cleanup. Under Lloyds Open Forum, the stern section was towed to Port Hawkesbury, Nova Scotia, to recover remaining oil. The bow section was towed to a deep water area 200 nautical miles off Nova Scotia and sunk by gunfire from the *HMCS Margaree* on April 1, 1979. Oil started coming ashore in April and two cleanup control centers were established at Low Point and Mulgrave, Nova Scotia. The oil continued to contaminate shorelines along the eastern coast of Nova Scotia throughout the summer.

Behavior of Oil:

Bunker C fuel oil is a heavy product with an API gravity that ranges from 7 to 14. The oil slick movement was very difficult to track and monitor because the oil appeared to float a meter or two below the surface of the water. Ice-oil mixtures, first seen on March 23, moved to the northwest during the following two days at a mean rate of 8 to 10 miles per day. Oil first came ashore on March 28, although the majority of oil did not come ashore until mid-April, after shore-fast ice was gone. Oil on the beaches was not in the form of mousse as expected, rather, it consisted of "toffee-like" particles ranging in diameter from millimeters to several meters.

The Cape Breton shoreline and the mainland coast of Nova Scotia were most severely contaminated. Oil washed ashore in varying amounts from St. Ann's Bay in north Cape Breton to as far south as Canso in Guysborough County, Nova Scotia. By April 14, Scatarie Island off the eastern extremity of Cape Breton Island and 25 miles to the southeast of Sydney was heavily oiled. Reports of oil on Fox Island were received on April 18. Oil was discovered on the Lingan sandbar on April 21. On gravel/cobble beaches, the oil often mixed with thick bands of accumulated kelp along the upper foreshore.

Oil continued to come ashore with little warning throughout the summer of 1979 along 700 miles of eastern Nova Scotia and southern Newfoundland shoreline. Cleanup operations lasted six months due to continual reoiling of beaches by tidal action.

Countermeasures and Mitigation:

In an attempt clean the oil from the ice before it reached the shoreline, the CCG fitted a barge with *backhoes, booms, and sorbent material*. The barge attempted to scoop the oil from the water with little success.

Rakes, shovels, and pitchforks were the main shoreline cleanup tools. The oil was very viscous by the time it reached the beach and was easily placed in sturdy plastic bags and 45 gallon drums. Ordinary *rakes* and *garden hoes* were carefully used in marsh areas to protect the root systems for future growth.

The CCG flew cleanup crews onto uninhabited Scatarie Island. *Manual cleaning methods* using hand tools, 45 gallon drums, and heavy plastic bags were employed. Over 1,000 barrels and 4,000 bags of oil and oil soaked debris were collected on the island within several days. A temporary *on-site incinerator was constructed to dispose of the oily waste*. The unit was modeled after a design developed by Trecan, Ltd. and the Petroleum Association for the Conservation of the Canadian Environment (PACE). The *Trecan-PACE incinerator*, constructed primarily of automobile parts and 45 gallon drums, was assembled on Scatarie Island next to the largest pile of debris-filled bags. Driftwood placed in the firebox was used to fuel the kiln. During peak operations, the kiln processed 350 bags of beach material an hour. The incinerator proved to be a cost-effective oil pollution countermeasure technique.

A total of approximately one million bags and 1,500 barrels of oily debris were collected over the 550 miles of shoreline that were accessible. Much of the oily waste was disposed of at *municipal landfills* and *strip mines* on Cape Breton Island. With increasing concerns over the amount of debris, new disposal sites were developed at Hadleyville, Forchu, and St. Peter's on Cape Breton Island.

Other Special Interest Issues:

Over 2,600 birds, primarily gulls and ducks, are known to have died as a result of oiling from this spill. The actual number of birds affected by this oil spill was much higher due to three primary factors. First, the slick was essentially hidden from view from March 16 to April 9. It is suspected that many oiled birds died during this period and sank. Second, little attempt was made during cleanup to separate, count and identify dead birds from among the other oiled debris. Third, much of the Cape Breton and Guysborough County shoreline was inaccessible, so dead birds on these beaches were not counted. Considering all factors, the bird mortality count from this incident is estimated at between 12,000 and 25,000.

This was the first incident involving oil/ice interactions in Canadian jurisdiction. Researchers from the Bedford Institute of Oceanography, Canada's Centre for Remote Sensing, the Environmental Protection Service,

and the Memorial University of Newfoundland studied these interactions extensively throughout the response.

References:

- Brown, R.G.B. and Johnson, B.C. 1979. The Effects of *Kurdistan* Oil on Seabirds. Scientific Studies During the *Kurdistan* Tanker Incident: Proceedings of a Workshop, 26-27 June 1979. pp. 203-211.
- Brown, R.G.B. Birds, Oil and the Canadian Environment, Oil and Dispersants in Canadian Seas- Research and Recommendations. Environment Canada. 1982.
- Gill S.D. and Stevens, G. 1980. Use of Trecan-Pace Oil Drum Incinerator During the *Kurdistan* Clean-Up Operation. Spill Technology Newsletter, v.5. pp. 9-14.
- Gundlach, E. and Marshall, M. 1990. The Physical Persistence of Spilled Oil: An Analysis of Oil Spills Previous to Exxon Valdez. Final Report. HAZMAT. OAD. NOAA. pp.47-68.
- Troop, P.M. and Greenham, CPT M.S. 1991. Ship-Source Oil Pollution Fund: 20 Years of Canada's Experience, Oil Spill Conference Proceedings, 1991, pp. 683-688.
- Vandermeulen, J.H. 1982. Oil Spills: What Have We Learned? Oil and Dispersants in Canadian Seas-Research Appraisal and Recommendations. Environment Canada. pp. 29-46.

Name of Spill: Lakehead Pipeline Company
Date of Spill (mmddyy): 03/03/91
Location of Spill: Grand Rapids, Minnesota
Latitude: 47 14 N
Longitude: 093 38 W
Oil Product: Crude Oil
Oil Type: Type 3
Barrels: 40,476
Source of Spill: Pipeline
Resources at Risk: Fish
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Adverse weather conditions, human health and safety concerns, logistical or operational problems, unusual or experimental cleanup techniques
Shoreline Types Impacted: Marshes, vegetated riverbank.
Keywords: Vacuum truck, boom, skimmers.

Incident Summary:

On March 3, 1991, a pipeline owned by the Lakehead Pipeline Company, Inc. in Grand Rapids, Minnesota, ruptured and *spilled over 40,000 barrels of crude oil* into the surrounding area. A resident in the area noticed the smell of oil and alerted the local fire department. The initial estimates by the company placed the size of the spill at 15,000 barrels. After rechecking volume figures, the company revised its estimate to 40,000 barrels. The spill occurred approximately two miles north of Grand Rapids.

Following the initial notification, the company shut off the valve to the pipeline. Approximately 300 people living in homes near the site were evacuated for safety, but were allowed to return to their homes later in the night. It was almost an hour after they had been notified before the company shut the pipeline down. It is believed that *this delay caused a significant increase in the size of the spill.*

Representatives from the U.S. Coast Guard (USCG), the Minnesota Pollution Control Agency (MPCA), the U.S. Environmental Protection Agency (EPA) Region V, the Minnesota Department of Emergency Management (DEM) and the Minnesota Department of Natural Resources (DNR) were on-scene and involved in the response.

Behavior of Oil:

The rupture caused pressurized oil to shoot from the pipeline into the air. Nearby trees were immediately coated with oil. Within a few hours, oil had spread into a wetland area and a storm sewer. The oil impacted the Prairie River, which is a tributary to the Mississippi River.

Some of the oil spilled onto the eighteen-inch thick ice sheets on the Prairie River. Oil formed into eight-inch deep pools on top of the ice in the middle of the river and was also present under the ice.

Countermeasures and Mitigation:

The responsible party hired almost twenty cleanup contractors to respond to the spill. The cleanup continued around the clock except when the weather was too cold to operate the equipment. Cleanup reportedly would have been much more difficult if the ice had melted, or warmer weather had allowed the oil to move more rapidly.

Vacuum trucks were used by cleanup personnel to remove the oil from the surface of the ice. Workers used squeegees to push the oil along the ice to a removal location. *Booms were used on the river by cutting a slot through the ice cover with chainsaws.* Ice that had been permeated with oil was chopped into blocks small enough to be carried away to a separate part of the river. Cleanup personnel sprayed the ice blocks with hot water to wash out the oil, which was then recovered with skimmers. Blocks that were only slightly contaminated were moved to lined holding tanks and broken up. The crushed ice was then allowed to melt to recover residual oil.

Other Special Interest Issues:

Samples of the river water, groundwater, and well water were taken to determine the effects of the spill. Air samples showed that the vapors were within safe breathing limits. A small number of fish were reported killed as a result of the spill in the immediate area where the oil entered the water.

References:

- Genwest Systems, Inc. communications with MPCA and MDNR.
- Oil Spill Intelligence Reports, 14 March 1991.

Name of Spill: MCN-5

Date of Spill (mmddyy): 1/31/88

Location of Spill: Guemes Channel, Shannon Point, Washington

Latitude: 48 31 N

Longitude: 122 42 W

Oil Product: Heavy Cycle Gas Oil, Intermediate Fuel Oil, Marine Diesel Oil

Oil Type: Type 4, Type 2

Barrels: 1604

Source of Spill: Tank Barge

Resources at Risk: Kelp, eelgrass beds, diving coastal birds, gulls, alcids, terns, raptors, bird nesting beaches, seal population concentration areas, seal haulouts, river otters, shrimp, crabs, oysters, clam harvest areas, scallops, abalone, anadromous fish, beaches, boat ramps, commercial fisheries, intakes.

Dispersants: No

Bioremediation: No

In-situ Burning: No

Other Special Interest: Complex salvage operations, research conducted, closure of shipping lanes or vehicle traffic routes, habitat impact due to oil.

Shoreline Types Impacted: Kelp beds.

Keywords: Washington Department of Natural Resources (WA DNR), Washington Department of Ecology (WA DOE), Pacific Strike Team (PST), Airspace Request Zone, Flight Restricted Area, skimmer, cannonball diaper sampler, sub-surface oil, sinking, salvage, boom, vegetation cutting.

Incident Summary:

At approximately 0330 on 31 January 1988, the master of the tug *James T. Quigg* reported that his tow, the Tank Barge MCN-5 had turned onto its port side. At the time of the incident, the tug and barge were turning to the south around Fidalgo Head, near Shannon Point, Washington. The barge was loaded with 9,874 barrels of Heavy Cycle Gas Oil (HCGO) and some residual lighter fuel oils when it departed the Texaco Facility at Anacortes, Washington, three hours earlier.

At 0530, the MCN-5 partially sank in an inverted position approximately three hundred yards off Shannon Point. The stern rested on the bottom in about 120 feet of water and the bow remained above the surface, supported by an air bubble in the forward rake. The barge remained in this position for more than a week while cleanup and salvage operations were organized. On February 8, the barge sank completely, coming to rest on its port side at an angle of 17 degrees to the bottom.

Less than 2,500 barrels of oil were released into the water. Because the high specific gravity of the cargo made it sink, there was little observed environmental damage.

Behavior of Oil:

The barge contained *9,874 barrels of Heavy Cycle Gas Oil* and approximately 524 barrels of residual Intermediate Fuel Oil (IFO) and Marine Diesel Oil (MDO) at the time of the incident. Marine diesel oil has an API gravity of 31.3, and a pour point of 23 degrees C. Approximately 2,177 barrels of HCGO and 278 barrels of the residual oils were released when the barge capsized and sank. This was all the product in the number one and number five cargo tanks.

The HCGO had a specific gravity of 1.086, which made it sink to the bottom or remain suspended in the water column. Its pour point was 40°, and when cold, the product was very thick and viscous in nature. The IFO and MDO residuals were less dense than the sea water and remained on the surface. This oil was generally observed as sheen spreading out from the area of the sunken barge. The observed sheen was determined to be too light to recover mechanically.

The oil contaminated the kelp beds on Fidalgo Island, Burrows Island, and Allan Island. The degree of oiling ranged from very light to heavy. The risk to the kelp beds was not great enough to warrant any removal action.

There were several small releases of oil during the salvage operations that were caused by pumping air into the barge's tanks to maintain buoyancy. These were generally between 3 and 25 barrels and occurred at slack tide and while the vessel was boomed off. Cleanup contractors estimated ninety-five percent recovery in these cases.

A diving survey of the sunken barge on February 9 revealed additional damage to No. 1 and No. 5 tanks and a pool of oil that had collected in the lee of the vessel. Swift currents at the bottom appeared to be dissipating the pool and the oil leaking from the damaged barge.

Disposable diapers attached to a cannonball weight and lowered to the bottom were used to detect the presence of the heavy oil on the bottom. This technique was used at the *Mobiloil* incident and provided a rapid qualitative estimate of the distribution of the sub-surface oil.

Countermeasures and Mitigation:

The National Oceanic and Atmospheric Administration (NOAA) Scientific Support Coordinator (SSC) recommended that the salvage operations be undertaken during slack and ebb tide. On February 28, two derrick barges commenced lifting the MCN-5 from the bottom. When the barge was at the surface, the remaining product was pumped off and the barge was rolled to an right-side-up position. Pumping and cleaning of the barge continued until March 1 when the lifting slings were removed and the derrick barges were released. On March 2, the MCN-5 was towed to a shipyard in Seattle. During the final lifting stages of the salvage operation, a large *inverted-plane type skimmer* was stationed on the ebb-current side of the barge and an *oleophilic belt-type skimmer* was stationed on the flood current side of the operation. The skimmers were connected with booms to contain any oil discharged during the operation. A tug and small *oleophilic rope-type skimmer* were stationed outside the containment barrier to collect any oil that escaped the booms.

An unknown quantity of the lighter residual oil was released during the salvage operations on February 28 which oiled kelp beds near Burrows Bay. *Washington Department of Natural Resources* (WDNR) personnel recommended that the oiled kelp not be removed because it was in a stage of growth at which it was not particularly sensitive to the effects of the oil. The oiled sections of kelp broke off naturally during the next month.

Other Special Interest Issues:

The USCG On-Scene Coordinator's (OSC) decision to raise the MCN-5 was based upon several considerations. By the time the salvage operation was federalized, substantial planning and salvage work for raising the barge had already been completed by the owners. Other available options were to leave the barge in place or to pump off the remaining cargo with the barge submerged. Leaving the barge in place was unacceptable to all parties concerned and pumping heavy, viscous oil from such a depth would have been very difficult. Pumping would also have presented the risk of the cargo tanks collapsing as they were emptied.

Three sea water intakes for the Shannon Point Marine Center, operated by Western Washington University, were located within one-half mile of the barge. Two of these intakes were located at the surface and one was near the bottom. All were potentially at risk from the released oil. Heavy oil on the bottom was observed near the intakes on April 7. A pan was placed beneath the bottom intake to prevent sediment and oil from being drawn into the system.

On July 7, 1988, the NOAA SSC attended a meeting with WA DOE, U.S. Fish and Wildlife Service, National Marine Fisheries Service, Institute of Marine Studies of the University of Washington, and USCG representatives to review the findings of benthic samples collected May 17. Four of the five

samples collected closely matched the profile of the HCGO cargo from the MCN-5.

The OSC requested that USCG District 13 Operations Center (OPCEN) officially close the airspace above the site during the salvage operations to prevent unauthorized aircraft from interfering with official overflights. During the initial stages of the salvage operations, the Federal Aviation Administration (FAA) granted the OSC an *Airspace Request Zone*, which requested, but not required, *aircraft avoidance within a one mile radius of the site up to 1,000 feet*. Notice of the Airspace Request Zone was promulgated through the OPCEN, Whidbey Island Naval Air Station (NAS), local airports, and local television news. On February 27, the closure was upgraded to a *Flight Restricted Area* to prevent additional hazards during the most critical stages of the salvage operation. The area was returned to an Airspace Request Zone on February 29. The OSC canceled all airspace restrictions on March 1.

Initially, Olympic Tug and Barge Co. of Seattle, Washington, accepted full financial responsibility for the response and the OSC was monitoring the events and coordinating the actions of the various organizations involved. The OSC assumed partial responsibility on February 10 after Olympic Tug and Barge demonstrated inability to provide a suitable salvage platform. The OSC assumed *full Federal responsibility* for the salvage operations on February 25 following Olympic Tug and Barge Co.'s inability to continue pollution cleanup and protection.

References:

- NOAA Hotline reports
- USCG On-Scene Coordinator's Report
- Yaroch, CDR. G.N. and LCDR. G.A. Reiter. The Tank Barge MCN-5: Lessons in Salvage and Response Operations. O.S.C.P. 1989. pp. 87-90.

Name of Spill: *Mega Borg*
Date of Spill (mmddyy): 06/08/90
Location of Spill: Gulf of Mexico, 57 miles southeast of Galveston, Texas
Latitude: 28 33 N
Longitude: 094 08 W
Oil Product: Angolan Palanca crude oil
Oil Type: Type 2
Barrels: 100,000
Source of Spill: Tank Vessel
Resources at Risk: Shrimp, fish, terns, gulls, beaches.
Dispersants: Yes
Bioremediation: Yes
In-situ Burning: Yes
Other Special Interest: Logistical or operational problems, media interest, volunteer response and organization, unusual or experimental cleanup techniques.
Shoreline Types Impacted: Marshes, fine sand beaches, sand/gravel beaches.
Keywords: Corexit 9527, skimmer, Air-Eye aircraft, side looking airborne radar (SLAR), Atlantic Strike Team (AST), U.S. Navy Supervisor of Salvage (NAVSUPSALV), AE BioSea Process, explosion, fire, contingency plan

Incident Summary:

On June 8, 1990 at approximately 2330, while the Italian tank vessel *Fraqmura* was lightering the Norwegian tank vessel *Mega Borg*, an explosion occurred in the pump room of the *Mega Borg*. The two ships were in the Gulf of Mexico, 57 miles southeast of Galveston Texas in international waters, but within the U.S. exclusive economic zone. As a result of the explosion, a fire started in the pump room and spread to the engine room. An *estimated 100,000 barrels* of Angolan Palanca crude was burned or released into the water from the *Mega Borg* during the next seven days.

Approximately 238 barrels of oil was discharged when the *Fraqmura* intentionally broke away from the *Mega Borg*. Explosions on the *Mega Borg*, caused the stern of the ship began to settle lower in the water and list to the port side. A continuous discharge of burning oil flowed over the aft port quarter of the ship.

Less than an hour after the explosions on the *Mega Borg*, the U.S. Coast Guard (USCG) in Galveston dispatched two USCG cutters to the scene.

Weather was calm throughout the incident. Winds were generally around 10 to 15 knots and air temperature were between 80 and 90 degrees Fahrenheit.

Behavior of Oil:

Palancan crude oil has an API gravity of 38.6, and a pour point of 50 degrees F. Responders believed that abnormally high freshwater runoff from the Sabine River and other rivers in the area would have a tendency to keep the oil offshore. Initially the oil moved northwest toward Corpus Christi. By June 18, the leading edge of the oil slick approached the environmentally sensitive area of Sabine Pass, but was kept offshore by winds and currents. After a few days it began to move to the north and east and first came ashore on the Southwestern Louisiana coast on June 28 in the form of small tarballs scattered over a distance of 18 miles. Shorelines that suffered oiling included Holly Beach and Dung Beach in Texas, Peveto Beach in Louisiana, and the Mermentau River in Louisiana. The tarballs on the shoreline amounted to very little oil.

The floating oil spread out into a light sheen. *Much of the spilled crude oil was lost to evaporation (as much as 50%) or burned.* Overflight observations generally noted light sheen on the water mixed with tarballs. A small amount of reddish colored mousse was also observed.

Countermeasures and Mitigation:

The initial focus of the response effort was to extinguish the fire on the *Mega Borg* and offload the remaining cargo. Firefighting vessels began to arrive on the morning of June 9. Over 50 commercial vessels and more than a dozen skimmers were used during the response. In addition, a USCG *Air-Eye* aircraft, equipped with *side-looking airborne radar (SLAR)*, was used to determine the distribution of the spilled oil.

Two more explosions occurred on board the *Mega Borg* on June 9. The fire was fueled by cargo from the No. 4 tank which was leaking into the engine/pump room. Initially, the vessel was so hot that it was feared that the application of foam to extinguish the fire might be ineffective or increase the possibility of explosion. Firefighters cooled the hull of the ship and attempted to prevent the fire from spreading to the other cargo tanks.

Six vessels were used to fight the fire. Four of the vessels hosed the *Mega Borg* with seawater in attempts to contain the fire and cool the vessel, and the other two vessels, which were equipped for foam application, kept the burning stern of the *Mega Borg* downwind.

Pump valves on the *Mega Borg* were secured (hydraulic block valves were operated manually) on 10 June in an attempt to stop the flow of oil. The oil continued to flow from the tanker, and later that day there were a series of new explosions on board. The explosions intensified the fire and caused the stern of the *Mega Borg* to become partially submerged, increasing the risk that the tanker would sink and release the remainder of its cargo.

By June 13, firefighting efforts had contained the blaze sufficiently to attempt foam application. The fire was out for almost an hour and a half while the foam was being applied, but then re-ignited. Firefighters resumed hosing the vessel with seawater until June 15, when a second foam application successfully extinguished the fire.

With the fire out and the vessel stabilized, responders filled the cargo tanks with inert gas to reduce the fire hazard. The remaining 809,500 barrels of oil were lightered off the *Mega Borg*, using two small tankers. Lightering was completed on July 27.

In preparation for the possible "worst case" oil release, involving over 833,000 barrels of cargo remaining on the *Mega Borg*, representatives from the USCG Marine Safety Office (MSO) Galveston, and state and Federal resource agencies met to draft a *coastal protection priority plan*.

Most of the *sensitive resources in the area are located inside the inlets*, and cleanup of the oil in the estuaries would be very difficult. For these reasons, the inlet areas were identified as the highest priority for protection. The protection plan did not focus on strategies for protection of the coastal beaches. The coastal beaches are generally fine grain beaches, allowing only minimal oil penetration into the sediments, and therefore making cleanup easier. In addition, deploying protection equipment (such as deflection boom) on coastal beaches would have been largely ineffective due to the high wave activity and tidal action of the area.

In order to implement the protection plan quickly, *twelve U.S. Navy Supervisor of Salvage (NAVSUPSALV) skimmers and 6,000 feet of 36-inch boom were staged in Galveston*. As the oil continued north, it threatened to impact the Texas Point National Wildlife Preserve at the mouth of the Sabine River. The main inlets in the area were boomed off and three of the Navy skimmers were sent to the Sabine area. The oil continued in an easterly direction, and did not impact the Preserve. Other sensitive areas where boom was deployed included Rollover Pass on the Bolivar Peninsula, High Island and Sea Rim State Park in Texas.

To reduce the amount of oiled waste onshore, debris was removed from sensitive areas prior to possible oil impact. NOAA recommended that organic debris not be removed from refuge shorelines where erosion was present, so that the shorelines would remain stable. Volunteers were used to remove debris from beaches west of Sea Rim Park through the Adopt A Beach Program supervised by the Texas Land Office.

Another contingency plan was made in the event of imminent sinking of the *Mega Borg*. The vessel would be towed inshore and run aground. Two tugs were standing by in the event of such a possibility. It was speculated that if it sank at its offshore location, the vessel might implode and release the remainder of its cargo.

On June 9, steps were taken to obtain dispersant approval in the event of a major release. Later that day, *dispersant use within 5 nautical miles of the Mega Borg was approved*, but dispersants were not expected to be used unless large amounts of oil were released. The Regional Response Team (RRT) requested that the dispersant trajectory be monitored and reported to the RRT if dispersants were used. Two commercial C-130 aircraft equipped for dispersant application were contracted from Florida and Arizona.

On June 10, *4,000 gallons of Exxon Corexit 9527* were applied to part of the oil slick. Observers noted a definite change in the texture of the oil slick after dispersant application. *Five sorties sprayed a total of 11,300 gallons of dispersant*. The winds were very calm during and after the application, which may not have provided enough mixing energy for maximum dispersion.

Bioremediation tests were conducted on June 15 and 18. These were the first tests of a bioremediation agent on an oil spill in open waters in the United States. The bioremediation agent used was *AE BioSea Process*, developed by Alpha Environmental, Inc. AE BioSea Process contains oil-metabolizing bacteria and nutrients. *The results of the tests were inconclusive*.

In the first few days of the response, skimmers focused on oil localized around the *Mega Borg*. As the oil spread and approached shorelines in Texas, and the flow of oil from the *Mega Borg* decreased and more of the skimmers were focused on the leading edge of the slick. During the response, extensive air support was required to direct skimming operations.

By June 16 the *Mega Borg* stopped leaking oil. Diver surveys of the vessel revealed that the hull of the *Mega Borg* was intact and structurally sound.

Skimming operations were scaled back by June 20, due to the lack of recoverable oil. On June 24, tarballs washed up on the shoreline of Louisiana. Most of the tarballs localized on a five mile stretch of coast near Peveto Beach. Beach crews manually picked up the majority of the tarballs. Some areas with a minimal amount of tarballs were not cleaned. The Louisiana Department of Environmental Quality advised that intervention could cause more environmental damage by erosion than leaving the tarballs on the beach. *A total of 13,023 barrels of oil and mousse were recovered in response operations. There were no reports of oiled wildlife from the incident.*

Other Special Interest Issues:

Media attention to the *Mega Borg* spill was intense. The USCG set up a media office with 11 USCG photojournalists and conducted two press briefings daily on vessel status and cleanup.

There were logistical problems associated with communications and response to a spill nearly 60 miles offshore. There were also communications delays with the owners of the vessel. Communications with offshore personnel were facilitated with cellular phones (Petrocom cellular service), high frequency radios and VHF-FM. USCG Air Station Houston became the logistical base for the oil spill; personnel and equipment were transported to the spill site and the Air Station became the staging area for much of the response equipment. *USCG Cutter Steadfast, equipped with a flight deck, was very useful for shuttling equipment and personnel to the site.*

Cleanup volunteers were coordinated by the Texas General Land Office and received an abbreviated Occupational Safety and Health Administration (OSHA) training course.

References:

- Hoff, R. 1991. A Summary of Bioremediation Applications Observed at Marine Oil Spills. Report HMRB 91-2. Jan. 1991.
- Leveille, LCDR T.P. 1991. The Mega Borg Fire and Oil Spill: A Case Study, Oil Spill Conference Proceedings, 1991, pp. 273-278.
- MMS Worldwide Tanker Spill Database.
- NOAA Hotline Reports.
- Oil Properties stack, CAMEO SSC (API 1986).
- OSIR Oil Spills, International Summary & Review, 1989-1990.
- Tanker Advisory Center, Inc. 1991 Guide for the Selection of Tankers. T.A.C. Inc. 1991.
- U.S. Coast Guard On-Scene Coordinator's Report.
- World Information Systems. Tanker Losses in U.S. Waters: 1978-1990.
- World Information Systems. 1991.

Name of Spill: *Metula*
Date of Spill (mmddyy): 08/09/74
Location of Spill: First Narrows, Strait of Magellan
Latitude: 52 34 S
Longitude: 069 41 W
Oil Product: Light Arabian Crude Oil and Bunker C.
Oil Type: Type 2, Type 4
Barrels: 398,020
Source of Spill: Tank Vessel
Resources at Risk: Diving birds, abundant mussel beds, bird rookeries, bird migratory routes, bird nesting beaches.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Adverse weather conditions, habitat impact due to oil, logistical or operational problems, research conducted, wildlife impacts.
Shoreline Types Impacted: Marshes, exposed tidal flats, sand/gravel beaches, mixed sediment beaches, salt marsh.
Keywords: Air-Deliverable Anti-Pollution Transfer System (ADAPTS), lightering.

Incident Summary:

On August 9, 1974, at 2220, the VLCC (Very Large Crude Carrier) *Metula* ran hard aground on Satellite Bank, at the western end of First Narrows in the Strait of Magellan near the southern tip of South America. The vessel was traveling from west to east at nearly fifteen knots and came to a stop in approximately 260 feet (the *Metula* was over 1,000 feet long and ordinarily required 3 miles to stop). Oil immediately began pouring into the water from ruptured cargo and fuel tanks.

Behavior of Oil:

Light Iranian crude oil has an API gravity of 33.4 and a pour point of -30 degrees F. Bunker C fuel oil is a heavy product with an API gravity that ranges from 7 to 14. The oil moved predominantly to the west into Bahia Felipe and Bahia Gregario, with lesser movement to the east into Bahia Posession. The oil was driven by currents as high as ten knots and winds from the northwest at thirty to fifty knots. Within the first three weeks, the wind forced the oil onto the northern shoreline of Tiera del Fuego. Oil deposited on the beach took on two different forms. A dark brown mousse with a five per cent water content plus sand, seaweed and other debris was deposited above the spring high-tide line and in the marshes and estuaries. A lighter mousse with a thirty per cent water in oil emulsion was deposited extensively in the intertidal zone.

The lighter mousse coated the beaches from 18 to 55 yards wide and up to 3 inches deep. Light mousse also covered the gravel and cobbles of the rocky intertidal area during low tide.

At Punta Espora, the intertidal flats near the ferry were paved with a mixture of mousse, sand, gravel, organisms and other debris. The observed area was more heavily covered in the January 1975 survey than at the time of the incident. *At sheltered tidal flats, as found at First Narrows, the thick asphalt-like covering persisted for over 12 years with no signs of significant weathering.*

In the heavily oiled *salt marsh*, *nearly all the vegetation was still dead over five years later*. Some of the less heavily oiled salt marshes showed signs of recovery after only five months.

Major contamination was still visible on the third survey, in January 1976, nearly seventeen months after the grounding. During this survey, the intertidal zone at Punta Espora was described as a paved roadway 550 to 650 yards wide and 1.5 to 2.5 miles long, and ranging from 4 to 12 inches thick. The seaward 100 yards of the intertidal zone had abundant algae and mussels, and most of the hard pavement there had eroded away.

Countermeasures and Mitigation:

There was no action taken to contain or disperse the oil that spilled from the *Metula*. Operations were hampered by rough weather, logistical difficulties and financial responsibility. For this reason, the *Metula* spill area became a natural laboratory for studying the long-term effects of oil on the environment.

Consideration had been given to cleanup. Boom was expected to be ineffective due to the strong currents and tides. Chemical dispersants and the equipment to apply them were not available. They would have been difficult to use and possibly ineffective due to the weather and tidal conditions. It was estimated that 5,000 tons of dispersant chemicals would have been required to disperse the quantity of oil spilled from the *Metula*. Lack of cleanup equipment and personnel would have made an effective beach cleanup impossible. Much of the affected shoreline was inaccessible to heavy equipment, even if the equipment had been available. There was also considerable concern about the possible damage to the environment caused by cleanup with chemicals or mechanical equipment.

Chilean authorities decided that cleanup of the beaches was not warranted, in view of other economic needs and the relative ecological importance of the area. It was felt that there was no way to have prevented the pollution of the beaches, and that the response effort was better spent on re-floating the vessel and preventing further spillage of oil.

Four lightering operations were carried out to remove enough of the remaining cargo from the vessel to facilitate re-floating. All three of the *USCG Air-Deliverable Anti-Pollution Transfer System (ADAPTS)* lightering pumps were used during all phases of the offloading and ballasting. Following the lightering operations, air was pumped into sealed compartments. As the air was pumped in, the ADAPTS pumps continued to

pump out ballast water in an effort to lighten and re-float the vessel. Two attempts were made, but the tugs were unable to pull it free of the rocks. On September 24, during a period of fifty knot winds, the *Metula* floated free and was pulled to a pre-selected anchorage approximately 13 miles from Punta Baxa. Offloading continued, despite periods of gale and hurricane force winds, until October 10. The USCG personnel and equipment departed the area on October 19.

Other Special Interest Issues:

Marine birds were very heavily affected by the spill. Observations during a September 14 to 16 survey conducted between Punta Anegada and Punta Piedra (nearly fifty miles of impacted beach), found 581 dead birds. This number included 84 seagulls, 23 ducks, 66 penguins, and 408 cormorants. Estimates of bird mortality ran as high as 2,000. A penguin migration from the Atlantic Ocean to rookery islands in the Strait of Magellan was a primary concern to scientists at the time of the spill. A worst-case scenario involved migration of tens of thousands of penguins. When this migration did finally occur in mid-September, the leaking from the *Metula* was stabilized and most of the spilled oil had already beached on the shore or in the estuaries.

USCG National Strike Force (NSF) personnel were sent to the site of the grounding at the request of the Chilean government. Ten people were on-scene to support and guide any cleanup measures that might be undertaken, and to assist with the salvage and lightering operations of the vessel. They arrived in Punta Arenas on August 27 with three Air-Deliverable Anti-Pollution Transfer System (ADAPTS) and their supporting gear.

Personnel from the National Oceanic and Atmospheric Administration (NOAA) arrived at the site of the grounding five months after the incident, during January 1975, as part of a U.S. team that included representatives of the Environmental Protection Agency (EPA) and the USCG. The team studied the effects of the oil on the habitats and marine life that were impacted by the spill.

References:

- 8/9/91 & 8/28/91 Letters from Daniel Owen at ITOPF
- Gundlach, E. and Marshall, M. 1990. The Physical Persistence of Spilled Oil: An Analysis of Oil Spills Previous to *Exxon Valdez*. Final Report. HAZMAT. OAD. NOAA. pp. 9-19.
- Gundlach, et al. 1978. Some Guidelines for Oil-Spill Control in Coastal Environments, Based on Field Studies of Four Oil Spills. Chemical Dispersants for the Control of Oil Spills, ASTM STP 659. L.T. McCarthy, Jr., G.P. Lindblom, and H.F. Walter, Eds. American Society for Testing and Materials. pp. 98-118.
- Gundlach, et al. 1982. Persistence of *METULA* Oil in the Strait of Magellan Six and One-Half Years After the Incident. The Physical Persistence of Spilled Oil: An Analysis of Oil Spills Previous to *Exxon Valdez*. Final Report. HAZMAT. OAD. NOAA. pp. A53-A64.
- Gunnerson, C.G. and Peter, G. 1976. The *Metula* Oil Spill. NOAA Special Report. September 1976.
- Hann, R.W. 1977. fate of oil from the supertanker *Metula*., Oil Spill Conference Proceedings 1977, pp. 465-468.
- Hooke, N. Modern Shipping Disasters 1963-1987. Lloyds of London Press. 1987.
- MMS Worldwide Tanker Spill Database
- Owens, et al. 1987. Observations From a Visit to the *Metula* Spill 12 Years After the Incident. Environment Canada. Spill Technology Newsletter. v.12. pp. 83-92.
- Review of Oil Spill Occurrences and Impacts, Exxon Production Research Company, 1989.
- Straughan, D. 1976. Biological Survey of Intertidal Areas in the Strait of Magellan in January 1975, Five Months After the *Metula* Oil Spill. The Physical Persistence of Spilled Oil: An Analysis of Oil Spills Previous to *Exxon Valdez*. Final Report. HAZMAT. OAD. NOAA. pp. A65-A78.
- Tanker Advisory Center, Inc. 1991 Guide for the Selection of Tankers. T.A.C. Inc. 1991.
- Vandermeulen, J.H. 1982. Oil Spills: What Have We Learned? Oil and Dispersants in Canadian Seas-Research Appraisal and Recommendations. Environment Canada. pp. 29-46.

Name of Spill: *Mobiloil*

Date of Spill (mmddyy): 03/19/84

Location of Spill: Warrior Rock, Columbia River, near Portland, Oregon

Latitude: 45 51 N

Longitude: 122 47 W

Oil Product: Heavy residual oil, industrial fuel oil, No. 6 Fuel Oil

Oil Type: Type 4

Barrels: 3925

Source of Spill: Tank Vessel

Resources at Risk: Wildlife refuge, deer, raptors, industrial water intakes, high-use recreational fishing areas, commercial fisheries, crab nursery areas, seal population concentration areas, waterfowl, waterfowl nesting beaches, waterfowl migratory routes, oysters, clams, recreational beaches, anadromous fish, spawning streams.

Dispersants: No

Bioremediation: No

In-situ Burning: No

Other Special Interest: Research conducted.

Shoreline Types Impacted: Marshes, fine sand beaches, vegetated riverbanks.

Keywords: Volunteers, sub-surface oil, boom, manual removal, reoiling, International Bird Rescue and Research Center (IBRRC), contingency plan, cannonball diaper sampler.

Incident Summary:

The Tank Vessel *Mobiloil*, while en route from Ferndale, Washington to Portland, Oregon, suffered a steering failure at 0005 on March 19, 1984 which resulted in the grounding of the vessel near Warrior Rock in the Columbia River approximately 10 miles downstream from Portland, Oregon. Punctures and gashes ruptured the number 1-5 starboard cargo tanks releasing 3,925 barrels of heavy residual oil, industrial fuel oil, and No. 6 fuel oil.

The vessel remained grounded perpendicular to the current until March 26, when it was refloated and escorted to dry dock in Portland. At the time of the spill the wind was from the south and the river current velocities were 1.5-3.0 knots. The incident occurred in a turbulent area of the river that experiences some tidal influence.

Behavior of Oil:

No. 6 fuel oil is a heavy product with an API gravity that ranges from 7 to 14. Spilled oil was distributed on the surface of the river, throughout the water column, and on the river bottom. The shoreline was not impacted as severely as anticipated. Areas thought to be thick oil were actually sheen. The only black oil observed on the surface occurred as small tar balls that were commonly found clinging to debris.

The sinking nature of the oil made estimates of the spill size difficult. Initial Mobil and USCG estimates of 1,000 barrels were revised after additional

information suggested that the majority of the oil had been incorporated into the water column and in the river bed. The primary transport mechanism for spilled oil was the flow of the Columbia River.

Shoreline areas downstream from the spill site were impacted by surface oil. These areas included sandy beaches, sloughs and islands. Beached oil was commonly found mixed with debris. Fluctuations in river height stranded oil on the river banks and caused *re-oiling* of affected areas.

A significant amount of oil remained on the surface and moved rapidly downstream. Surface oil exited the river or was trapped along the shoreline within two or three days. Southerly winds tended to concentrate the oil on the northern side of the river causing shoreline impacts mainly on the Washington shorelines. Pancake shaped tarballs of up to 6 inches in diameter impacted some downstream locations.

Sub-surface oil moved downstream in the same manner as the surface oil within a meter of the bottom. *Mid-water oils rose to the surface in the area of seawater intrusion.* Oil on the river bottom formed a pool in the eddy area created by the hull of the *Mobiloil*. National Oceanic and Atmospheric Administration (NOAA) personnel estimated the pool to contain between 250 and 1,000 barrels of oil. This oil moved downstream when the vessel was refloated.

Predicted flushing rates for the spilled oil ranged from a few days for surface oil to several weeks for bottom concentrations. Spilled materials that exited the river were deflected north within the river plume and impacted the beaches of the Washington coast mainly in the form of tarballs. Long-term trajectory estimates by NOAA personnel suggested the possibility of widely scattered tarball impacts on the beaches to the south of the river due to seasonal changes in the prevailing currents along the coastline.

Countermeasures and Mitigation:

Due to the swift current conditions, open water recovery was not effective. Much of the oil escaped under booms placed downstream from the vessel. The distribution of oil throughout the water column made recovery difficult.

Environmental Emergency Services (EES) was contracted by Mobil Oil to conduct the cleanup operation. The local experience and knowledge of the river provided by EES personnel proved valuable in placing booms in the dark. Shoreline cleanup was accomplished through manual removal of oil and debris. *Cleanup operations were hampered by strong currents, the inaccessibility of many impacted areas, and the large quantities of debris involved.* The shoreline cleanup operation extended over a distance of 120 miles. Cleanup crews were transported to many sites by boat. Heavy equipment was used in areas that contained very large amounts of oiled debris. Heavy equipment operations at areas not accessible from shore required a crane barge, storage barge, and bulldozer. Oil on hatchery ponds was recovered with *sorbent rolls*.

There were no reported attempts to recover oil in the water column. Discovery of the oil that sank to the river bottom was attempted by lowering *weighted sorbents* to the bottom. This method proved successful when oil escaped from the vessel during dry docking.

Oregon Department of Environmental Quality (ODEQ) estimated that 3,000 cubic yards of oiled debris were removed from Washington shorelines during the effort that recovered a total of 833 barrels of oil. NOAA personnel reported low oil-to-debris ratios for the riverbank recovery and higher (up to 60%) ratios for the outer beaches. Mobil estimates of the volume recovered were based on two gallons of oil in each 20 gallon plastic bag of debris.

NOAA personnel conducted a fate and effects study which concluded that the initial Mobil spill estimate of 1,000 barrels was too low, and that as of April 2 the majority of the oil had either been recovered or flushed from the river. Analysis of water samples found no presence of the highly toxic water soluble fractions. Heavy aromatics were found in the tissue of sturgeon, and data indicated that naphthalenes could be dissolved in water. The National Marine Fisheries Service (NMFS) conducted benthic sampling and monitoring of fishes and Dungeness Crab by trawl survey.

The Oregon Department of Fish and Wildlife (ODFW) monitored fish by test-fishing and continued annual monitoring of spring Chinook salmon runs. The ODEQ updated the Columbia River Oil Spill Contingency Plan. The U.S. Fish and Wildlife Service (USFWS) performed continued monitoring of impacts on seabirds. Washington Department of Ecology (WDOE) conducted chemical monitoring of fishes and shoreline surveys. WDOE and Washington Department of Fisheries (WDF) staff deployed cages containing live fish to monitor toxicity. No mortality was observed during these 96-hour tests.

Due to the number of Federal and state agencies having jurisdiction in the Columbia River, a meeting was called on March 23 to coordinate the effort. The meeting involved Federal agency representatives from the Department of Interior (DOI), USCG, and NOAA, as well as state agencies from Oregon and Washington. The state agencies and DOI representatives were to continue biological assessment and record any oil impacts. NOAA personnel continued to study the transport, trajectory, and fate of the oil, and acted as central coordinator for all agencies. NOAA also developed an environmental sampling plan to ensure that any research gaps would be filled.

Other Special Interest Issues:

There was wide agreement among the agencies involved that the presence of a *Columbia River Oil Spill Contingency Plan* expedited the organization of the cleanup and resource assessment. The quick response and assumption of liability by Mobil Oil allowed Federal and the state agencies to concentrate on monitoring and data collection. The agencies agreed to share information and coordinate research activities regarding the fate and effects of the spill.

The resulting study was planned and executed within a few days. NOAA pursued the methodology used for possible future operating procedures.

Seabirds and *waterfowl* were impacted along the river and on the outer coast. Reports of the number of affected birds range from 698 birds received, 475 treated and released (NOAA) to 450 received and 284 released (Mobil). Species involved were Western Grebes, Surf Scoters, Common Murres, White-winged Scoters, and Black Scoters. Initially, bird cleaning and treatment were carried out by personnel from the *Portland Audubon Society* until a rescue center could be established by the *International Bird Rescue Research Center*. No effects on Bald Eagles or Snowy Plovers were observed.

Recovery of oiled birds involved the use of *volunteers*, USCG personnel, Audubon Society members, and representatives from the International Bird Rescue Research Center. Initially, volunteers collected and transported the birds to the centers. Due to the large area involved, the USCG agreed to collect and transport any birds brought to their stations. Sixty-three to sixty-eight per cent of the birds taken to the centers were reportedly treated and released.

Catches of various fish were received by state agencies including sturgeon, petrale sole, and surf perch. Chemical sampling of sturgeon showed high concentrations of heavy naphthalenes. Oiling of *shellfish beds* on the coastal beaches occurred at Willapa Bay and Grays Harbor. The oiling of oyster shell material at Grays Harbor was considered a minimal loss of substrate for juvenile oyster recruitment. Two reports of oiling proved to be natural occurrences, one of jellyfish (*Vellela*) and the second, an algal bloom.

The resources at risk included harbor seal populations that contained mostly pregnant females preparing to pup, the immediate scheduled hatchery release of several million juvenile salmon, the *Lewis and Clark National Wildlife Refuge*, and the *Columbia Whitetail Deer National Wildlife Refuge*. Several threatened or endangered species including the Bald Eagle, Snowy Plover, Columbia Whitetail Deer, and Peregrine Falcon were of concern. Feeding and nursery areas for shellfish, fish, birds, and mammals occur along the river and the coastal beaches. Also at risk were resources important to sport and commercial fisheries.

Oil in the water column caused the *contamination of the water intake system* of one industrial facility. Filters on the system were alternately cleaned to mitigate any further potential problem. Hatchery ponds at the Trojan Nuclear Power Plant were oiled with sheen. The salmon that were introduced to the ponds the day of the incident were examined nine days later and found to be within acceptable physiological limits.

References:

- Fate and effects of the Mobiloil spill in the Columbia River, NOAA
- Park, W.C. 1985. Response to the Mobiloil spill incident, Oil Spill Conference Proceedings, 1985, pp. 335-339
- Sutherland, G.B. 1985. The value of natural resource protection plans under actual spill conditions, Oil Spill Conference Proceedings, 1985, pp. 93-96.

Name of Spill: *Nestucca*

Date of Spill (mmddyy): 12/23/88

Location of Spill: Grays Harbor, Washington

Latitude: 46 55 N

Longitude: 124 15 W

Oil Product: Bunker C

Oil Type: Type 4

Barrels: 5,500

Source of Spill: Tank Barge

Resources at Risk: Eelgrass, diving coastal birds, waterfowl, shorebirds, wading birds, raptors, seals, sea otters, oysters, crabs, clams, commercial fisheries.

Dispersants: No

Bioremediation: No

In-situ Burning: Yes

Other Special Interest: Closure of commercial fishing areas, effects to recreational areas, interaction with foreign or Native authorities, experimental cleanup techniques, volunteer response and organization, wildlife impacts, wildlife rehabilitation.

Shoreline Types Impacted: Marshes, sand/gravel beaches, tidal mudflats, exposed rocky shores, vertical rocky shores.

Keywords: International Bird Rescue and Research Center (IBRRC), oil snares, pompoms, sub-surface oil, manual removal, vegetation cutting, collision, disposal, volunteers.

Incident Summary:

In the early morning of December 23, 1988, the tug *Ocean Service* collided with its tow, the barge *Nestucca*, while trying to replace a broken tow line. Both the barge and tug were owned by Sause Brothers Ocean Towing Co. of Coos Bay, Oregon and were en route from Ferndale, Washington to Portland, Oregon when the collision occurred approximately 3 kilometers off the coast of Washington, near Grays Harbor. The barge was carrying over 69,000 barrels of Number 6 fuel oil. The tug punctured a cargo tank, releasing an estimated 5500 barrels of the heavy marine fuel into the ocean. It was an overcast, moonlit night and the vessels were reportedly rolling in 6 to 10 foot swells.

Behavior of Oil:

Bunker C fuel oil is a heavy product with an API gravity that ranges from 7 to 14. The oil began to impact the beaches in Grays Harbor on the morning of the spill, and was reported to be spreading to the north. By noon on December 23, 1988, USCG personnel at Westport reported that beaches inside Grays Harbor were covered with 1/2 inch thick patches of oil. Washington Department of Ecology (DOE) representatives reported that oil was washing ashore near Ocean Shores, Washington. Offshore oil was observed mainly in the form of light sheen with small patches and pancakes of oil. The oil impacted several coastal beaches in the area of Ocean Shores in the first five days. No oil from this spill was observed on beaches south of Grays Harbor.

first five days. No oil from this spill was observed on beaches south of Grays Harbor.

The oil moving north formed sheen; however, it was later determined that a substantial slick was moving beneath the surface. The initial estimates of the amount spilled were inaccurate and only small globules of oil could be detected at sea by December 29, 1988.

Oil came ashore in Canada on Vancouver Island from near Victoria in the southeast to near Cape Scott in the north. Along the coastline, the CCG estimated that a total of about 95 miles of shoreline were oiled, with 1.5 miles heavily oiled. The first impact of oil was on December 31, 1988, at Carmanah Point, on the west coast of Vancouver Island. Over the next 15 days, the oil reached to Cape Scott at the northwest tip of Vancouver Island. On January 27, 1989, oiled material, determined to be from the *Nestucca*, was found in the Moore Islands area on the mainland of British Columbia.

Countermeasures and Mitigation:

There was no attempt made at open water recovery by Canadian or U.S. authorities. High seas and currents precluded the use of containment booms, as did the fact that the oil was frequently not detected at sea before beaching. The use of skimmers and other methods of oil recovery were deemed to be ineffective as surface oil was not contained in booms. The USCG On-Scene Coordinator (OSC) did not seek authorization for dispersant use because approval was unlikely, and use of dispersants on Bunker C oil would likely be ineffective after the considerable weathering of the oil.

Grays Harbor consists of marshes and tidal flats, mostly mudflats. The Scientific Support Coordinator (SSC) from the National Oceanic and Atmospheric Administration (NOAA) recommended that no cleanup of the mudflats be attempted.

The *U.S. National Park Service (NPS)* strictly monitored helicopter use in the Olympic National Park, Washington, area due to the presence of Bald Eagles in the area. Many of the affected locations along the northern part of the Washington coastline were extremely inaccessible to vehicles and cleanup equipment. Some oiled driftwood had to be cut up and removed by helicopter for disposal. Cleanup personnel needed special permission from the NPS to use power tools within the Olympic National Park grounds.

Most of the shoreline cleanup was manual. Oiled debris and gravel were shoveled and raked into plastic bags that were eventually sling-loaded by helicopter to a disposal site (or trucked if the area was accessible by roads). *Petromesh*, *oil snares*, and oil-absorbing *pompoms* were used to scrape and absorb oil from the boulders, eelgrass, and beach sand.

Cleanup of the shoreline was completed by April 21, 1989, when most of Washington's beaches were declared clean by the OSC. Passive cleaning using

anchored oil snares continued at Norwegian Memorial and Yellow Bank for another two months. Both sites are within Olympic National Park.

Other Special Interest Issues:

Several experimental techniques were tested for use in cleaning up the shoreline. Under experimental conditions at the CCG Base at Amphirite Point, *napalm* was used to burn oil off contaminated rocks. This was not put to real use during the spill because the napalm did not burn enough of the oil during the tests. At Bajo Point, *flame throwers* (Tiger Torches) were tested on the environmentally sensitive cobble beach. This was not used during the cleanup because it moved the oil, risking the formation of new slicks on the water and the contamination of the gravel substrata.

At Bajo Point, a beach near a sea otter colony, an archaeological site, and an Indian Reserve, oil contaminated cobbles and gravel were burned in a reciprocating kiln between February 20 and 25. This was inefficient because of both the small amount of oil and huge quantity of contaminated material requiring treatment. At several locations heavily oiled logs were burned. These included some important tourist beaches and several islands in the Pacific Rim National Park. On West Coast Trail beaches, oiled logs were experimentally burned on oiled gravel, burning to a depth of half a meter. This method was then put in practice at Estevan, Brooks Peninsula, Nootka Island, and islands within Pacific Rim National Park in the Broken Group Islands. In the Stubbs Island area, contaminated eelgrass was cut and removed during low tide. The eelgrass is a crucial link in the food chain in this ecosystem.

Oiled debris and logs were burned at sites approved by the Washington DOE. Approximately 585 tons of non-burnable debris was disposed of in the Aberdeen, Washington landfill.

Sea otters, harbor seals, Pacific oysters, and Dungeness crabs are also present, and were believed to be at risk. In the coastal waters, marine diving birds and the coastal razor clam fisheries were believed to be at risk. While high mortality was not expected among the crabs and clams, their tainting would make them unfit for harvesting for months.

The most disastrous impact as a result of the spill was to waterfowl. Many species of waterfowl are present in Grays Harbor, including Double-crested and Pelagic Cormorants, Common Murres, Rhinoceros Auklets, diving and dabbling ducks and assorted shorebirds. Overwintering Peregrine Falcons and Bald Eagles are also present in the bay. More than 10,300 oiled birds were collected; roughly 9,300 were dead or died at the treatment centers. Most of these were Common Murres and assorted grebes (Western, Red-necked, Horned and Eared Grebes all winter in this area). Many more were believed to have died and never collected.

The responsible party hired an expert from the International Bird Rescue Research Center (IBRRC) who used volunteers and personnel from the

Washington Department of Ecology (DOE) and the Washington Conservation Corps (WCC) to staff the bird rescue and rehabilitation center at Ocean Shores, Washington. Over 3,000 birds were treated at the center, two-thirds of which died. Approximately 1,000 birds were released from the center.

The Bald Eagle, fish, shellfish, and sea otter communities that were at risk were determined to be unaffected by the spill or response by the Washington Marine Resource Damage Assessment Team. No tainting of shellfish was reported nor were any fisheries reportedly closed as a result of the spill. On January 6, 1989, the Canadian Department of Fisheries and Oceans *closed two shellfish areas* on Vancouver Island to prevent possibly contaminated shellfish from reaching the market.

References

- Gundlach, E. and Marshall, M. 1990. The Physical Persistence of Spilled Oil: An Analysis of Oil Spills Previous to *Exxon Valdez*. Final Report. HAZMAT. OAD. NOAA. pp. 47-68.
- *Nestucca* Oil Spill Report, Canadian Coast Guard, June 1989
- NOAA Response Report
- Owens, E.H. 1991. Shoreline Evaluation Methods Developed During the *Nestucca* Response in British Columbia. Oil Spill Conference Proceedings, 1991, pp. 177-179.
- U.S. Coast Guard On-Scene Coordinator's Report
- Washington State Department of Ecology, *Nestucca* Oil Spill On-Scene Coordinator's Report, August 1989.
- Yaroeh, G.N. 1991. The *Nestucca* Major Oil Spill: A Christmas Story, Oil Spill Conference Proceedings, 1991, pp. 263-266.

Name of Spill: *Nord Pacific*
Date of Spill (mmddyy): 07/13/88
Location of Spill: Inner Harbor, Corpus Christi, Texas
Latitude: 27 48.7 N
Longitude: 097 24.8 W
Oil Product: Beatrice (North Sea) crude oil
Oil Type: Type 2
Barrels: 15,350
Source of Spill: Tank Vessel
Resources at Risk: Power plant water intakes, marshes.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Closure of shipping lanes or vehicle traffic routes.
Shoreline Types Impacted: Piers, marshes.
Keywords: Atlantic Strike Team (AST), containment boom, vacuum truck, evaporation, propane cannons, air horns, volunteers, sorbents, filter fence, Regional Response Team, Elastol, low pressure washing.

Incident Summary:

On the night of July 13, 1988, the *Nord Pacific* suffered hull damage while docking at the Southwestern Oil and Refinery Dock #3, on the south side of the inner harbor, Corpus Christi, Texas. The collision with the dock tore an 8 foot by 1 foot hole in the No. 6 port wing tank about one foot above the waterline. The *Nord Pacific* was carrying 625,000 barrels of Beatrice crude oil, 15,350 barrels of which spilled into the harbor before the tank could be pumped down. The spill response began immediately and lasted until July 22. This spill was a textbook case of things that went well, including favorable weather conditions, no fire at the time of collision, rapid response, minimum resources at risk, direct access to all impacted areas, and small tidal range in a dead-end harbor.

Behavior of Oil:

Beatrice crude is a medium weight crude with a specific gravity of 0.83 and a pour point of 13 degrees Celsius. An estimated twenty five percent of the oil evaporated in the first two days of the spill, and by the end of the third day all free-floating oil in the harbor had been removed. Of the 15,350 barrels spilled, 11,344 barrels, (74%) were recovered. The oil slick was contained in a 2.6 mile long section of the inner harbor with most oil impacts on the north bank. Rocks and beaches were cleaned with relative ease. One hundred eighteen cubic yards of oiled debris were collected.

Countermeasures and Mitigation:

Utara Shipping, the owner of the tanker, assumed responsibility for the spill. They contracted Corpus Christi Area Oil Spill Association and Miller Environmental Services to clean up the spill. Personnel from Garner Marine Services, and later, from O'Brien Oil Pollution Services, were hired to manage the contractors and coordinate with the United States Coast Guard (USCG). Within one hour after the collision with the dock, 1,400 feet of containment boom was in place around the vessel. Oil from the damaged tank was pumped into an empty tank, and within minutes after the boom was in place the vessel stopped leaking oil. Less than two hours later, two vacuum trucks were removing oil from the harbor.

The Atlantic Strike Team (AST) was activated and arrived on scene July 14. By the early morning of July 14, three vacuum trucks were operating on scene, and 4,000 feet of boom stretched across the harbor at three separate locations. At the height of the response, 20 vacuum trucks were operating. Overflights began to survey the cleanup. *A small quantity of oil entered a power plant water intake* despite precautionary booming, and was discharged into Nueces Bay. The Nueces Bay slick dissipated rapidly. On July 16, the On Scene Coordinator (OSC) received permission from the Regional Response Team (RRT) to apply *Elastol, an oil viscoelastic enhancing agent*, to the slick. Conditions for use included conducting an initial test phase and continuous monitoring of the application. Due to the effectiveness of other response measures, Elastol was never used.

From July 17 to July 22 the response personnel focused on removing oiled debris, and further cleaning of two marsh areas. On July 19, *a filter fence* was put up at the Tule Lake marsh area, which worked effectively in protecting that area. Sorbents were deployed at the Centex Cement marsh area on July 21. The response ended on July 22.

Other Special Interest Issues:

The Coast Guard Captain of the Port (COTP) closed the Corpus Christi Inner Harbor to vessel traffic from July 13 to July 18. One-way, daytime traffic was permitted on July 16. Traffic from the spill area was closely monitored to ensure that oiled vessels were clean before entering unoiled areas.

Texas Parks and Wildlife, Texas Water Commission, and United States Fish and Wildlife Service (FWS) monitored the spills effects on fish and waterfowl. The FWS coordinated volunteers to operate propane cannons and air horns in efforts to keep birds away from oiled areas. There were few impacts to fish and wildlife. The FWS continued to monitor the marshes after the spill response ended.

References:

- Alejandro, CAPT A.C. and Crickard, LT A.M. 1989. Corpus Christi Catastrophe: Case of Classic Cleanup, Oil Spill Conference Proceedings, 1989, pp. 71-76.
- Golobs 1978-1989 US Spill Report
- MMS Worldwide Tanker Spill Database
- OSIR Oil Spills, International Summary & Review, 1986-1988
- OSIR, August 1, 1988, Vol. XI, No.31
- Tanker Advisory Center, Inc. 1991 Guide for the Selection of Tankers. T.A.C. Inc. 1991.
- USCG On-Scene Coordinators Report
- World Information Systems. Tanker Losses in U.S. Waters: 1978-1990. World Information Systems. 1991.

Name of Spill: Nowruz Oil Field
Date of Spill (mmddyy): 02/10/83
Location of Spill: Persian Gulf, Iran
Latitude: 29 32 N
Longitude: 049 35 E
Oil Product: Crude oil
Oil Type: Type 3
Barrels: 1,904,762
Source of Spill: Platforms
Resources at Risk: Power plant water intakes, drinking water intakes, industrial water intakes, mangroves, salt marshes, sand/gravel beaches, intertidal mudflats, seagrass beds, coral reefs, fishes, waterfowl, shrimp, oysters, shorebirds, bird wintering areas, bird migratory stopover areas, wading birds, crabs.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Human health and safety concerns.
Shoreline Types Impacted: Sand/gravel beaches.
Keywords: Booms, skimmers, fire, collision.

Incident Summary:

In 1983, the Nowruz Oil Field in the Persian Gulf, Iran, was involved in a number of oil pollution incidents. On February 10, 1983, a tanker collided with a platform. The platform developed a 45-degree tilt and had to be shut down. Wave action and corrosion apparently caused the riser to collapse into the wellhead causing a spill of approximately 1,500 barrels per day. The well was not capped because the field was in the middle of the Iran/Iraq war zone. This platform was attacked by Iraqi planes in March and the resulting slick caught fire. This well was capped by the Iranians on September 18, 1983. Eleven people were killed during the operation.

In March 1983, a nearby platform was attacked with rockets by Iraqi helicopters. The platform burned and spilled oil at an initial rate of approximately 5,000 barrels per day. *The rate slowed to about 1,500 barrels per day in the two years before the well was capped.* In May 1985, the fire was extinguished and the well was plugged with the assistance of divers. Nine men died during these operations. Approximately 733,000 barrels of oil spilled into the sea as a result of this incident. It is estimated that the *rate of oil leaking into the Persian Gulf in mid-May of 1983 was between 4,000 and 10,000 barrels per day* due to more war-related activity or the collapse of burning platforms.

As a result of this incident, a cooperative program for large-scale trajectory modeling was developed between the National Oceanic and Atmospheric Administration and Kuwait's Environment Protection Council under the Ministry of Public Health.

Behavior of Oil:

The Nowruz field crude oil had an API gravity of 22. Detailed information of the movement of the oil was not readily available since much of the slick was in a restricted war zone. An estimated 2/3 of the oil sank to the bottom as tarballs after sand carried by high winds mixed with the oil.

Countermeasures and Mitigation:

Norpol, a Norwegian company, used *booms* and *skimmers* in responding to the spill.

References:

- Galt, et al. 1983. Trajectory Analysis for the Nowruz Oil Spill with Specific Applications to Kuwait. MASS, HAZMAT, NOAA.
- IFP. PLATFORM DATABANK On Accidents to Drilling Vessels or Offshore Platforms (1955-1989).
- Oil Spill Intelligence Report, 2/21/91.
- Oil Spill Intelligence Report. Oil Spills, International Summary & Review, 1982-1985.

Name of Spill: *Ocean Eagle*
Date of Spill (mmddyy): 03/03/68
Location of Spill: San Juan, Puerto Rico
Latitude: 18 29 N
Longitude: 066 10 W
Oil Product: Venezuelan light crude oil
Oil Type: Type 2
Barrels: 83,400
Source of Spill: Tank Vessel
Resources at Risk: Recreational beaches, diving coastal birds, lobster, fish, octopus.
Dispersants: Yes
Bioremediation: No
In-situ Burning: No
Other Special Interest: Effects to tourism, closure of shipping lanes or vehicle traffic routes, effects to recreation areas, volunteer response and organization, wildlife impacts, wildlife rehabilitation, adverse weather conditions.
Shoreline Types Impacted: Sand/gravel beaches, exposed rocky shores.
Keywords: Sorbents, manual removal, emulsifier, sinking.

Incident Summary:

On the morning of March 3, 1968, the tanker *Ocean Eagle* grounded in the harbor of San Juan, Puerto Rico. The vessel broke in two several hours after the grounding, spilling Venezuelan light crude oil into the harbor. The aft section of the vessel drifted farther into the harbor and grounded, while the forward section was anchored in place. Three days later, U. S. Navy tugs tried to tow the forward section out of the harbor. Adverse weather hindered the operation, and eventually drove the forward section farther into the harbor. On March 10, the forward section broke open in heavy seas and released more oil into the water. By the first week of April, both parts of the tanker were lightered and towed out to sea where they were sunk.

Behavior of Oil:

Over 70,000 barrels of oil spilled into the San Juan Harbor. A slick one inch thick covered most of the harbor. Approximately 16 miles of Condado beaches were oiled.

Countermeasures and Mitigation:

Representatives from the USCG, the United States Navy (USN), the Federal Water Pollution Control Administration, and the United States Army Corps of Engineers (COE) arrived on-scene to assist in the response. Spill response included the use of sorbents, dispersants, and mechanical and manual removal of the oil from beaches. The U. S. Navy began spraying the *emulsifier Wyandot 20* on the slick on the afternoon of March 3. Emulsifiers were spread in Condado Lagoon on April 8. While the emulsifiers used were effective, it was not clear that they did not complicate the effects of the oil on the environment. *Ekoperl, an absorbent*, was spread on the slick.

Murphy Pacific Marine Salvage Company, under contract to the U. S. Army Corps of Engineers, was responsible for the offloading and removal of the stern section, while the U.S. Navy was responsible for the bow. On April 3, the Navy finished lightering operations after recovering approximately 24,000 barrels of oil, and towed the bow off its grounding location. The bow was sunk eight miles from San Juan on the next day, but continued to leak some oil. On April 15, the stern section was towed off its grounding location, and was also sunk eight miles out to sea.

Other Special Interest Issues:

Dispersants turned portions of the beaches into quicksand.

A bird rehabilitation center was operated by USCG volunteers, and treated 70 pelicans. Other bird rescue stations were established and staffed by tourist and civilian volunteers from San Juan. Approximately 300 pelicans were killed by oiling. A marine biologist from the University of Puerto Rico reported mortalities among sea urchins, spiny lobsters, and fish. Dead octopuses were also found.

Hotels along the beaches received many cancellations, and some closed down during the worst part of the spill.

Suspension of fishing was recommended by the Puerto Rican Department of Health, and most commercial and recreational fishermen complied.

The USCG temporarily closed the channel into San Juan Harbor during the days following the grounding and while the sections were towed from the harbor.

References:

- 8/9/91 & 8/28/91 Letters from Daniel Owen at ITOPF
- Hooke, N. Modern Shipping Disasters 1963-1987. Lloyds of London Press. 1987.
- Potter, J. 1973. Disaster By Oil. The Macmillan Company, NY. pp. 44-116.
- Tanker Advisory Center, Inc. 1991 Guide for the Selection of Tankers. T.A.C. Inc. 1991.
- Wilson, M.P. Jr., et al., "The Spreading, Retention and Clean-up of Oil Spills," URI, Kingston, RI, 1976.

Name of Spill: *Olympic Alliance*
Date of Spill (mmddyy): 11/12/75
Location of Spill: Dover Strait, Pas de Calais, English Channel
Latitude: 50 59 N
Longitude: 001 35 W
Oil Product: Iranian light crude oil
Oil Type: Type 2
Barrels: 87,000
Source of Spill: Tank Vessel
Resources at Risk: Recreation beaches, power plant water intakes, marinas, welk, alcid, fish.
Dispersants: Yes
Bioremediation: No
In-situ Burning: No
Other Special Interest: Adverse weather conditions, logistical or operational problems, wildlife impacts, wildlife rehabilitation.
Shoreline Types Impacted: Sand/gravel beaches, coarse gravel beaches,
Keywords: BP 1100X, skimmer, Shell Oil Herder, collision, International Tanker Owners Pollution Federation (ITOPF).

Incident Summary:

Shortly after midnight on the morning of November 12, 1975, the tank vessel *Olympic Alliance* and the Royal Navy Frigate, HMS *Achilles* collided in Dover Strait. The collision occurred in the northeast traffic lane about 13 miles southeast of Dover, England. One of the *Olympic Alliance's* cargo tanks was ruptured on impact resulting in the release of 14,000 barrels of Iranian crude oil. The vessels were able to separate without assistance. Visibility at the time of the collision was restricted by fog.

Response equipment and personnel were mobilized immediately in accordance with the local contingency plans. Vessels from a variety of sources were obtained for use in the application of dispersant. The Kent County Council (KCC) Oil Pollution Officer activated the county's contingency plan and arranged for three fishing vessels to be equipped with dispersant spraying equipment. The District Councils, Southern Water Authority, Nature Conservancy Council, Ministry of Agriculture, Fisheries and Food Sea Fisheries Officer, as well as the coastal power stations were all alerted of the incident. The forward base of operations was established at Dover.

Much of the resulting slick was dispersed by natural forces and the application of 2,000 metric tons of the hydrocarbon, solvent-based dispersant BP 1100X. Dispersant was applied in offshore and nearshore areas by surface vessel spraying. Shoreline oiling was estimated at 2,200 barrels. Sand and coarse gravel recreational beaches were oiled. Response activities were concluded on November 18.

The vessel was reported to have spilled an additional 73,000 barrels of oil between the site of the collision and Wilhelmshaven, West Germany.

Behavior of Oil:

Light Iranian crude oil is a medium weight product with an API gravity of 33.4 and a pour point of -30 degrees F. The spilled oil initially formed medium to heavy streaks and patches within the vessel traffic lanes of Dover Strait. Some lighter pollution was observed to the north, apparently created as the *Olympic Alliance* continued up the coast. As the spill progressed, observed concentrations of oil decreased due to natural and chemical dispersion. The bulk of the remaining oil moved to the west, toward the coast of England. As of November 13, no oil had washed ashore, though the closest slick was less than a mile offshore of Folkestone. The predicted areas of landfall included the beaches and shoreline between Deal and Hythe.

By November 14, oil had entered Folkestone Harbor and impacted the nearby shores at East Cliff Sands. Coarse gravel beaches near Deal were also oiled. Much of the oil that came ashore on the sand beaches was washed off by the tides. *The washing off of the oil was attributed to the pre-treatment of the beaches with Shell Oil Herder.* Oiling of sandy, low energy beaches near Folkestone was extensive. A wide band of oil 100 to 250 meters in width was observed on low profile beaches. High profile, high energy gravel areas at Dover and Deal were characterized by a narrower 3 meter band of oil 15-30 centimeters in depth. The exposed rocky shores between Dover and Deal were severely oiled. Many of the large tide pools were filled with oil.

During the late afternoon of November 14, the winds shifted to the northwest and moved the remaining floating oil away from the coast.

Countermeasures and Mitigation:

By 0800 on November 12, four dispersant spraying vessels were being prepared for operations. A tug and three fishing vessels were prepared by DOT and KCC personnel. The tug, a dedicated oil spill response vessel, was being loaded with dispersant, while the fishing vessels were outfitted with spraying gear. A tug from Southampton and a Royal Navy vessel from Chatham were also en route to the site to apply dispersant.

Initially the vessel operations were hampered by fog. As the fog lifted slightly, the vessels began applying dispersant while aided by aircraft observation reports. The fishing vessels operated in the Varne Bank area where shallow water depths prohibited the use of the larger vessels.

Fog persisted though the day, while the vessels sprayed nearly 700 gallons of concentrated dispersant and 6,000 gallons of non-concentrated dispersant on moderate to heavy slicks. Operations were halted in the evening since the vessels were dangerously exposed in the shipping lanes. By dusk on November 12, the main slick was still at sea, approximately 7.5 miles southeast of Dover. By the following day, ten vessels were involved in spraying dispersant in areas of medium to heavy streaks and patches. Two French vessels were employed to investigate reports of oil slicks in the southwest shipping lanes.

As the slick moved closer to shore, dispersant applications were concentrated in the Folkestone area, where both French and English spraying vessels operated into the night, sometimes very near shore. On November 13, 20,000 gallons of non-concentrated and 400 gallons of concentrated dispersant were applied. On November 14, one of the spraying vessels was dispatched to search for oil slicks near the Dungeness Atomic Power Station. Spraying operations were concluded on November 15, after an additional 1,500 gallons of non-concentrated dispersant were applied near Folkestone Harbor. Throughout the operation, *a total of approximately 2,000 tons of BP 1100X were applied to the floating oil.*

Two Vikoma Sea Packs, comprised of inflatable boom, were used to protect the harbor at Folkestone. Two fishing vessels and a heavy crane were required to deploy 1,600 feet of inflatable boom. Oiling of the harbor occurred after oil floated around the boom deployed at the harbor entrance. *Vikoma, Oil Mop, and Komara skimmers* were used to recover floating oil in and around the harbor. Recovery rates for the Oil mop and Komara Mini Skimmers were estimated at 7.3 barrels per hour, whereas the Vikoma Sea Skimmers recovered an estimated 73 barrels per hour. The recovery rates were lower than normal due to the high water and dispersant content of the slicks.

The inflatable boom, which captured up to 1,500 barrels of oil, deflated due to the failure of an air compressor. The weight of the captured oil also caused the boom to drag its anchors. Once reinflated, one of the floatation cells in the boom burst. The boom failure prevented responders from towing the boomed oil offshore and dispersing it with chemicals. *Polypropylene ropes were floated in the harbor to contain oil that escaped from the failing boom.* One of the fishing vessels was deployed to spray the boomed oil with dispersant. When the tides receded, dispersant was applied to oiled areas by hand-held sprayers and backpack equipment.

Oiled shorelines were cleaned using chemical and mechanical techniques. *The beaches at East Cliff Sands were pre-treated with 80 gallons of Shell Oil Herder in an effort to mitigate possible oiling.* Oil failed to adhere to the pre-treated beaches, and much of the oil either refloated off the beach or was collected mechanically using heavy equipment. Oiled beaches were also treated with dispersant using back pack spraying units.

Cleanup operations were suspended on November 18, when authorities determined that the beaches had been restored and the harbor was clear of oil.

Other Special Interest Issues:

Fog and the inability to communicate with the vessels from shore or the air caused logistical problems. The efficiency of the spraying vessels was questioned by responders. Improperly rigged spraying gear and the bow wake of vessels also caused problems. The use of vessels of opportunity resulted in *less than optimum dispersant application due to the bow wake of the vessel pushing the oil away from the dispersant spray.* The use of concentrated

dispersant, which was mixed with seawater by metered pumps, allowed vessels to operate for extended periods without returning to port for reloading.

There were 199 bird casualties reported during the incident, of which 77 were recovered dead and 122 were recovered alive and incapacitated. Most of the identifiable bird casualties were Guillemots, Cormorants and Razorbills. Cormorants were particularly affected, due to a high percentage of the population becoming oiled. Some unexpected species that were recovered included a Brent Goose, Tufted Duck, and Coot. Approximately 100 Gulls were observed to be slightly oiled and apparently unharmed. Gulls that were oiled included Greater Black Backed Gulls, Herring Gulls, and Common Gulls. Some dead fish and a damaged welk bed were reported.

References:

- Dixon, T.R. and Dixon T.J. 1976. Olympic Alliance Oil Spillage. Marine Pollution Bulletin. v.7, n.5. pp. 86-90.
- Genwest Systems, Inc. communications with ITOPF representatives.
- Nichols, J.A. and Parker, H. 1985. Dispersants: Comparison of Laboratory Tests & Field Trials with Practical Experience at Spills, Oil Spill Conference Proceedings, 1985, pp. 421-427.

Name of Spill: *Olympic Glory*
Date of Spill (mmddyy): 01/28/81
Location of Spill: Houston Ship Channel, Texas
Latitude: 29 41 N
Longitude: 095 00 W
Oil Product: Galeota crude
Oil Type: Type 3
Barrels: 20,000
Source of Spill: Tank Vessel
Resources at Risk: saltwater marshes, abundant oyster beds, wildlife preserves, marinas.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Adverse weather conditions, logistical or operational problems, human health and safety concerns, media interest.
Shoreline Types Impacted: Sand/gravel beaches, sheltered rocky shores, sheltered marshes, marinas.
Keywords: Gulf Strike Team (GST), containment boom, vacuum truck, vacuum pumps, adverse weather conditions, collision.

Incident Summary:

On January 28, 1981, at 0940, the chemical tanker *Lucor Wickliffe* struck the Tank Vessel *Olympic Glory* on the port quarter, in the vicinity of the cargo tanks. The collision occurred approximately two miles south of Morgan's Point. After the *Olympic Glory* moored at Barbours Cut, an inspection diver confirmed the presence of a 6 by 12 foot hole in the vessel's No. 6 port wing tank. Approximately 20,000 barrels of Galeota crude were lost before the damaged tank could be lightered by portable pumps.

First day response efforts focused on containment of the spilled product. Crowley Environmental was contracted by the owners of the *Olympic Glory* to lead the cleanup effort. Crowley subcontracted four other cleanup companies to aid in the operation. Cleanup operations were divided into three separated zones. Zone 1 covered the areas between Morgan's Point and the Houston Yacht Club Marina. Zone 2 covered the northern areas from Morgan's Point to the Exxon Refinery at Baytown, and included Upper San Jacinto Bay. Zone 3 covered Barbours Cut. Barbours Cut also served as the location of the cleanup operation's command post.

Parties involved in the cleanup included the U.S. Coast Guard, Texas Department of Parks and Wildlife, Gulf Strike Team (GST), and Coast Guard Marine Safety Office, Houston. Approximately 18,000 barrels of spilled product was successfully removed within 30 days. The remaining 2,000 barrels were determined to be lost to natural dissipation.

Behavior of Oil:

Galeota crude has an API gravity of 32.8. In Zone 1, heavy concentrations of oil up to 3 inches thick and 30 feet in width impacted approximately 1.5 miles of private residential shoreline south of Morgan's Point. A wind shift caused the oil to migrate southwest, oiling the north side of the Houston Yacht Club Marina. Following another wind shift, back to the southeast, the oil moved to the northeast along the shoreline. Most of this oil was contained and recovered by the evening of January 31. Approximately 100 barrels remained along some inaccessible areas of shoreline. This remaining oil quickly migrated south 14 miles, coming ashore at Dollar Point.

The closing of a flood gate prevented the oil from entering the environmentally sensitive area of Moses Lake. A wind shift the following morning, entrained oil under triple boom at the mouth of Little Cedar Bayou. Strong wind driven currents pushed this escaping oil to the southwest. Boom that was previously placed along the north side of the Houston Yacht Club Marina trapped the oil (estimated at 1,500 barrels) for recovery. A total of 5,000 barrels of oil were removed from Zone 1 by February 4.

In Zone 2, one thousand barrels of oil spread into several inaccessible areas. Heavy oiling was observed at both Black Duck Bay and the intake basin of Houston Light and Power Company, located in Upper San Jacinto Bay. Cleanup of the Zone 2 areas was completed by February 4.

By the end of the first day some areas in Zone 3 were oiled to a depth of 8 inches. Approximately 14,000 barrels of oil were contained by boom in this area. Dirt roads and levees contributed to truck damage and access problems in the Barbours Cut area. The most accessible location could not be used for oil containment because it was a collection and fleeting point for barges. One of the barges in the fleeting area spilled an unknown quantity of styrene. *Cleanup operations were halted for three days, to protect cleanup personnel from the hazardous styrene fumes.* Cleanup operations within Zone 3 were completed February 25.

Countermeasures and Mitigation:

While the vessel was moored at Barbours Cut, portable pumps were used to lighten the remaining oil from the ruptured No. 6 wing tank. The release of oil was stopped by 1530 the day of the incident.

A 2,000 foot section of *containment boom* was placed around the entire vessel and across Barbours Cut within an hour after the vessel was moored. This quick containment response greatly reduced the amount of oil that escaped from the mooring area. Booms were also placed on the north side of the Houston Yacht Club Marina, while the mouth of Cedar Bayou was triple boomed.

Several *vacuum pumps* were used to remove oil from the sand beach areas in all three cleanup zones. Vacuum trucks were also used to "chase" and

collect the oil which was pushed through the Houston Yacht Club area by the shifting winds.

Closing of the *flood gate* near Dollar Point protected the sensitive, sheltered salt marshes that line the Moses Lake area. Oil that was contained in this area was removed by laborers using a vacuum truck and front end loader.

Tank barges were used to transport the recovered oil to the AMOCO Refinery in Texas City. Oil contaminated with styrene that was refused by AMOCO, was taken to an approved local disposal site. Contaminated soil and oily debris were removed to an approved site in Port Arthur, Texas.

Other Special Interest Issues:

Frequent shifts in wind direction hampered cleanup efforts. Weather forecasts that were wired from a distant National Weather Service office failed to accurately predict the shifting winds. Wind shifts commonly occurred before they were predicted.

The barge fleet area at the west end of Barbours Cut was crowded with active barges. Although barge fleet movements in Zone 3 interfered with clean-up efforts, closing down the fleet for more than five days would have created an excessive financial burden on barge owners and operators.

Relying on Crowley Environmental to supervise all other contractors resulted in the slow implementation of plans. Additional personnel were not dispatched to assist the cleanup until the fifth day. The lack of sufficient numbers of personnel early in the response resulted in a slow initial cleanup effort.

Media coverage of the incident was favorable. *The USCG District 8 Public Affairs Office was the single contact point for the media.* This relieved the burden from others involved with the response, and ensured that all media members were getting consistent and current information on the progress of the cleanup operation.

References:

- Golobs 1978-1989 US Spill Report
- MMS Worldwide Tanker Spill Database
- Oil Spill Intelligence Report. Oil Spills, International Summary & Review, 1978-1981
- Tanker Advisory Center, Inc. 1991 Guide for the Selection of Tankers. T.A.C. Inc. 1991.
- U.S. Coast Guard On-Scene Coordinator's Report
- World Information Systems. Tanker Losses in U.S. Waters: 1978-1990. World Information Systems. 1991.

Name of Spill: *Pac Baroness*

Date of Spill (mmddyy): 09/21/87

Location of Spill: 12 miles southwest of Point Conception, California

Latitude: 34 21 N

Longitude: 120 45 W

Oil Product: Bunker Fuel (IFO 180 and diesel), lube oil, hydraulic oil.

Oil Type: Type 3, Type 4, Type 4.

Barrels: 9,200

Source of Spill: Non-Tank Vessel.

Resources at Risk: Exposed rocky shores, sand/gravel beaches, sheltered marshes, sheltered tidal flats, wavecut platforms, marine mammals, birds, fish, mollusks, crustaceans, resource extraction, recreation, management areas

Dispersants: Yes

Bioremediation: No

In-situ Burning: No

Other Special Interest: Adverse weather conditions, logistical or operational problems, research conducted.

Shoreline Types Impacted: None

Keywords: International Bird Rescue and Research Center (IBRRC), adverse weather conditions, Elastol, Davidson Current, side-looking airborne radar (SLAR), skimmer.

Incident Summary:

On September 21, 1987 at 0600, the Liberian bulk carrier *Pac Baroness* and the Panamanian freighter *Atlantic Wing* collided in foggy, high sea conditions, twelve miles southwest of Point Conception, California. The *Pac Baroness* was carrying 21,000 metric tons of dry bulk copper concentrate consisting of 30% copper, 30% iron, 30% other oxides and approximately 9,200 barrels of bunker fuel (IFO-180 and marine diesel fuel) as well as quantities of lube oil and hydraulic oil. The *Atlantic Wing* was carrying automobiles and was bound for Long Beach.

The *Pac Baroness* sustained damage to the number 4 and 5 cargo holds and the *Atlantic Wing* suffered a 25 foot by 10 foot gash in her bow. The Chief Engineer on board the *Pac Baroness* activated the vessel's bilge pumps and a tug attached a towline to the vessel to prevent the *Pac Baroness* from drifting toward the shoreline. By 1607, the *Pac Baroness* was still taking on water and was close to sinking. The *Pac Baroness* sank at 1618 on September 21, resulting in a release of approximately 9,200 barrels of oil and quantities of copper ore over the next 20 days. The currents at the time of the incident were to the northwest at 3-4 knots; winds in the area were from the N-NW at 10 knots. The seasonal Davidson Current flows north along isobaths at about 0.25 knots.

The Clean Seas Co-op was originally conducting cleanup on behalf of the owners of the *Pac Baroness*. On September 24, Clean Seas notified the U.S. Coast Guard's (USCG) Federal On Scene Coordinator (FOSC) that they would no longer be continuing operations due to disagreements over their contract with the owners. The FOSC declared the incident a Federal response and

opened the 311 (k) fund. The USCG began negotiations to contract Clean Seas as part of the Federal response. By September 28, Clean Seas had resumed working for the owners of the *Pac Baroness*, with the agreement that the owners would finance the Clean Seas response inclusive of the period from September 24 to September 28.

Behavior of Oil:

The oil slick initially extended from the sunken *Pac Baroness* for a distance of 1 mile to the southwest. By mid-day on September 22, the slick was 6 miles to the south of the *Pac Baroness*. Responders were initially concerned about toxicity from the spill because of the copper sulfide mixture that may have been present. The National Oceanic and Atmospheric Administration (NOAA) predicted that potential toxicity problems would remain localized due to the insolubility of copper sulfide.

Oil from the sunken ship rose to the surface but was not successfully collected using containment boom. The slick had a light sheen appearance and spread quickly from the source, breaking up approximately one-half mile from the source. Responders predicted that isolated cohesive patches of oil, if found, would move south and west of San Miguel Island due to weak counterclockwise circulation around San Miguel Island and wind conditions.

At the time of the incident many birds and mammals were present on San Miguel Island (part of the Channel Islands National Marine Sanctuary) with the highest concentration present on the western tip of Pt. Bennett. The exposure of marine diving birds (Brown Pelicans, Cormorants, Black Storm-Petrels) and the Golden and Guadeloupe fur seals was of concern. Initially, wind and currents kept the slick offshore, away from San Miguel Island, but on September 24, winds increased in strength and changed direction causing the oil slick to move south toward San Miguel Island. By the following day, weather conditions had improved and less oil was surfacing from the wreck and the threat to San Miguel Island had diminished.

No oiled shorelines were reported as a result of the incident. The *Pac Baroness* continued to leak small quantities of oil after the sinking and was monitored by the USCG in conjunction with the Minerals Management Service.

Countermeasures and Mitigation:

Weather conditions were poor during the spill response, with reduced visibility and rough sea conditions prohibiting extensive mechanical cleanup operations. Three dispersant trials were conducted during the response.

Three Clean Seas oil spill response vessels were on scene from September 22 to September 25 and one vessel from September 25 to September 29. Clean Seas contracted services and equipment to supplement their own response equipment. Mechanical containment and cleanup operations were hindered

by wind and sea conditions but recovery operations collected approximately 350 barrels of oil during the second and third days of the spill.

Observation of the oil slick from both sea vessels and aircraft was hindered by fog during the response effort. *The USCG AirEye system side-looking airborne radar (SLAR) system was used to track the position of oil when visual observations were impaired.*

Dispersant application required approval by the USCG FOSC, the Environmental Protection Agency, California Fish and Game, NOAA Marine Sanctuaries, and the National Parks Service. A test evaluation of dispersants was authorized and carried out on September 22. *A DC-4 aircraft specially equipped for dispersant application was used for test application of dispersant.* Approximately 100 gallons of Corexit 9527 was used on a 1.4-mile by 120-foot area of oil on the water at a ratio of 5 gallons per acre.

A second application took place on September 24, using the same technique and spraying 250 gallons of dispersant on windrows of oil near San Miguel island. Two helicopters with observers were present during the second application and *their reports on the effectiveness of the dispersant application varied.*

By September 25, two of the three Clean Seas vessels were retired from the response due to the lack of recoverable oil. The remaining vessel, with an *ODI VOSS skimming system*, performed skimming as weather allowed, but high winds and seas made operations difficult. The oil was spreading and dissipating rapidly after surfacing from the sunken *Pac Baroness*. The weir-type skimming device on the Clean Seas vessel was not able to collect the light sheen. An attempt was made to deploy deflection boom between two vessels and concentrate the oil for skimming, but increasingly high seas and damage to boom forced skimming crews to abandon the effort.

A third dispersant application took place on September 29 for *research purposes*. Two vessels, two helicopters and the USCG SLAR aboard a surveillance Falcon aircraft were used for this application. A surface drogue was deployed in the middle of the dispersant application area and measured fluorescence for almost 2 hours after application. Fluorescence measurements and water column samples were taken following dispersant application to determine the levels of petroleum hydrocarbons in the area of application. Levels of petroleum hydrocarbons in the top 10 meters of the water column were determined to be no higher than background levels after dispersant application, but it was not certain from visual observations if the slick was being dispersed chemically or by the increasing winds.

On October 1, phase II of the previous dispersant trial was to take place, but winds of up to 30 knots and seas of 8 to 10 feet forced postponement of the test until the following day. A representative of GTA Additives Inc. applied a *small amount of Elastol to oil near the source, but no effect was observed* by NOAA personnel.

On October 2, the phase II dispersant application was canceled due to continuing high winds and seas, and a consensus among observers of the previous test that there was no conclusive evidence that the dispersants were effective.

Other Special Interest Issues:

Wildlife impacts during the incident were minimal. California Department of Fish and Game managed the oiled bird response operations with the assistance of Clean Seas and a representative from the International Bird Rescue Research Center at Berkeley, California. The Ventura County Animal Control facility was used for rehabilitation operations. Before dispersant application, NOAA provided the USCG with dispersant checklist information which addressed concerns about exposure of wildlife to dispersed oil vs. non-dispersed oil. The dispersed oil was considered to be a lesser threat than the undispersed oil.

The USCG and Clean Seas spent significant time negotiating a contract amount as they did not have a Basic Ordering Agreement (BOA) established in advance of the incident.

Effective radio communications were limited during the response. In the Santa Barbara area, personnel were able to utilize the Clean Seas local repeater network with radios borrowed from the co-op.

An oceanographic survey of the sunken *Pac Baroness* was conducted in November of 1987. High resolution side scanning sonar was used to locate the vessel. Results of the survey showed that the vessel had hit bottom with significant force, and had disrupted the seafloor. Scientists speculated that this impact to the seafloor could negatively affect the marine life in that area. Analysis of the tissue of heart urchins collected from the area showed increased copper content.

A post-spill study was conducted by Battelle Ocean Systems to examine the distribution and levels of hydrocarbons in surficial sediments and the effects of the copper and oil spill on the infaunal community near the wreck site. Sediment samples taken near the wreck site revealed a patchy distribution of oil contamination. Hydrocarbon levels at sampling locations within 500 meters of the wreck ranged from 2 to 100 times that of background levels. Effects to the macroinfauna were documented by significant reductions in species abundance and mean numbers of individuals. Possible causes of the observed decreases include physical disturbance by the wreck itself or chemical contamination by oil or copper. Oil was noticed on the surface and within the gut cavities of some organisms.

References:

- Clean Seas' Response to the "PACBARONESS" Oil Spill, January 1988
- Clean Seas' Response to the Sinking of the *Pac Baroness*, Oil Spill Conference Proceedings, 1989, pp. 91-93.
- Environmental Effects of the *Pac Baroness* Oil and Copper Spill, Oil Spill Conference Proceedings, 1989, pp. 413-419.
- Modern Shipping Disasters 1963-1987 (p.355)
- NOAA Hotline Reports
- NOAA Response Report
- U.S. Coast Guard On-Scene Coordinator's Report

Name of Spill: *Pacific Glory*
Date of Spill (mmddyy): 10/23/70
Location of Spill: Isle of Wight, England
Latitude: 50 35 N
Longitude: 001 20 W
Oil Product: Nigerian crude oil
Oil Type: Type 3
Barrels: 24,780
Source of Spill: Tank Vessel
Resources at Risk: Fringing wetlands, tidal mudflats.
Dispersants: Yes
Bioremediation: No
In-situ Burning: No
Other Special Interest: Volunteer response and organization.
Shoreline Types Impacted:
Keywords: Fire, collision, explosion, International Tanker Owners Pollution Federation (ITOPF).

Incident Summary:

On the evening of October 23, 1970, the tanker *Pacific Glory* and the tanker *Allegro* collided six miles off the Isle of Wight, England. The *Pacific Glory* caught fire, and was taken under tow as firefighting tugs tried to control the fire. Explosions ruptured a starboard tank, and led to the flooding of the engine space. The next day, the tanker began to settle and eventually touched bottom at a point four miles from the shore. The *Allegro* continued on from the collision site under her own power.

Behavior of Oil:

The initial leak stopped soon after the collision, but as explosions occurred on the *Pacific Glory* additional leaks started from a starboard tank. The tank contained 35,400 barrels of Nigerian crude oil. Some of the oil burned, but approximately 24,780 barrels of oil spilled from the tank, forming three slicks. Very little oil came ashore, but some oil impacted Brighton and Selsey.

Countermeasures and Mitigation:

Tugs from the Department of Trade and Industry began spraying dispersant, and managed to dissipate a three-mile long slick. Wooden frames were towed behind the tugs to agitate the slicks and to facilitate the action of the dispersants. Two other slicks dissipated in the heavy seas without the use of chemical dispersants.

The owners of the *Pacific Glory* hired L. Smit, a salvage company, to fight fires and conduct salvage operations. L. Smit took the operations over from the Royal Navy on October 27.

On October 29, the Shell tanker *Halia* came alongside the *Pacific Glory* to offload some of her remaining fuel. The oil was pumped with eight portable

submersible electric pumps that were lowered into the cargo tanks. The *Halia* recovered 10,600 barrels of oil before adverse weather caused her to suspend operations until the next day. Lightering operations resumed with the *Halia* on November 5, and ultimately 44,000 barrels of oil were recovered. The *Pacific Glory* was refloated on November 6, and towed to Lymes Bay, England where water was pumped from her tanks in preparation for the completion of her journey. The *Pacific Glory* arrived in Europoort on November 17, and offloaded the rest of her oil. Approximately 453,120 barrels of oil were recovered from the tanker.

Other Special Interest Issues:

Local organizations, both public and private, were on watch in case any wildlife were impacted by the oil. The Royal Society for the Protection of Birds reported that very few oiled birds came ashore. Rescue operations were carried out by the Royal Navy, most of the crew was rescued. Fourteen people lost their lives during this incident.

References:

- Genwest Systems, Inc. communications with ITOPF representatives.
- Hooke, N. Modern Shipping Disasters 1963-1987. Lloyds of London Press. 1987.

Name of Spill: *Patmos*
Date of Spill (mmddyy): 03/21/85
Location of Spill: Straits of Messina, Sicily, Italy
Latitude: 38 15 N
Longitude: 015 35 E
Oil Product: Kirkuk Crude Oil
Oil Type: Type 2
Barrels: 5,300
Source of Spill: Tank Vessel
Resources at Risk: Recreational beaches, commercial fisheries.
Dispersants: Yes
Bioremediation: No
In-situ Burning: No
Other Special Interest: Effects to tourism.
Shoreline Types Impacted: Sand/gravel beaches.
Keywords: Containment boom, skimmer, manual removal, collision, fire, International Tanker Owners Pollution Federation (ITOPF).

Incident Summary:

On March 21, 1985, the *Patmos* and the *Castillo de Montearagon* collided in the Straits of Messina. The *Patmos* was carrying 828,300 barrels of Kirkuk crude oil while the *Castillo de Montearagon* was in ballast. The *Patmos* caught fire and was grounded on the beach of Villagio Torre Faro, Sicily. Firefighters subsequently towed the vessel off the beach to maneuver it for firefighting efforts. The fire was extinguished on March 23, and the *Patmos* was brought to dock at Messina, Sicily.

Behavior of Oil:

Kirkuk Crude Oil has an API gravity of 35.1, and a pour point of -8 degrees F. Approximately 5,300 barrels of Kirkuk crude oil spilled from the *Patmos*. The majority of the spilled oil moved south through the Straits of Messina. Most of the oil broke up in the variable currents of the strait, forming separate slicks that moved south at different rates. Some of the oil initially released moved to the north due to tidal currents. By March 23, most of the oil to the north had dissipated, but there was some sheen and mousse in the area. As the oil moved south it incorporated garbage, amounts of which typically exist in the waters east of Sicily. A slick of about 750 barrels remained off the coast near Taormina in spite of onshore winds, for two days. Small amounts of oil impacted the shore near Agnone Bagni, Capo Campoloto, and Pozzillo. The rest of the oil moved to the southeast away from Sicily and dissipated in the sea.

Countermeasures and Mitigation:

The Harbor Master at Messina was in charge of firefighting and salvage operations. The Harbor Masters at Messina, Catania, Augusta, and Syracuse were responsible for cleanup of oil at sea and on the land in their respective areas.

Dispersant application was conducted in Messina on March 22 and 23. Operations were done from a variety of vessels outfitted with spray booms or fire monitors. There was no regular supervision by aircraft of the dispersant operations, and a great deal of dispersant was applied ineffectively. The complicated movement of the oil in the strait hindered operations. By March 23, the oil had emulsified enough to be impervious to dispersants. Thereafter, dispersants were applied only to fresh oil near the *Patmos*. On March 24, containment and recovery operations began with the *Columbia Tide*. While the oil was containable with booms, the slick had incorporated so much garbage that it was not recoverable with skimmers. Five other skimming vessels were deployed at Messina, but had little success in recovering oil.

In the Catania area, approximately 3,100 gallons of dispersants were applied by aircraft. However, the oil had emulsified and collected garbage, and was not amenable to dispersing. Furthermore, the dispersant was hydrocarbon based and would not be effective when applied from aircraft. Skimming operations in the Catania area met with little success. Eventually, the vessels were used to break up the oil by traversing the slick at high speeds.

The oil off Augusta was so emulsified, and had picked up so much garbage, that recovery at sea was done with pitchforks. The beach at Agnone was oiled. Cleanup operations were conducted by Salvesen Offshore Limited with local contracted labor manually removing oil and oiled garbage. Five tons of oiled debris were picked up from the beach. Very little oil reached Syracuse as the slicks had begun to move in a southeasterly direction away from Sicily.

Other Special Interest Issues:

Fishing continued in the oiled areas, and no complaints about the quality of the fish were reported.

The oil did not come ashore in many places, and the tourist trade was not considered to be adversely affected by the presence of the oil on the water.

References:

- Genwest Systems, Inc. communications with ITOPF representatives.
- International Oil Pollution Compensation Fund Annual Report 1988.
- International Oil Pollution Compensation Fund Annual Report 1989.
- International Oil Pollution Compensation Fund Annual Report 1990.
- International Oil Pollution Compensation Fund Annual Report 1991.
- Kang, P.B. et al, Analysis of Significant Oil Spill Incidents From Ships, 1976-1985. Oil Spill Conference Proceedings 1987, p. 46

Name of Spill: *Peck Slip*
Date of Spill (mmddyy): 12/19/78
Location of Spill: Cabo San Juan, Puerto Rico
Latitude: 18 15 N
Longitude: 065 34 W
Oil Product: Bunker C
Oil Type: Type 4
Barrels: 11,000
Source of Spill: Tank Barge
Resources at Risk: Beaches, marinas, manatees, sea turtles, diving coastal birds, mangroves.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Logistical or operational problems, research conducted.
Shoreline Types Impacted: Fine sand beaches, coarse sand beaches, coarse gravel beaches, mangroves, consolidated seawalls.
Keywords: Vacuum truck, high pressure washing, Corexit 9527, Gulf Strike Team (GST), National Strike Force (NSF), sorbents.

Incident Summary:

On the morning of December 19, 1978, in unusually heavy seas, the *T/B Peck Slip* struck the bottom near Cabo San Juan off the northeast corner of Puerto Rico. The barge, carrying 80,000 barrels of Bunker C crude oil, suffered structural damage and immediately began to spill oil. The barge was towed back to Yabucoa Harbor. The owner of the barge reported a spill of a few barrels to the Marine Safety Office (MSO) San Juan. Approximately 2 hours after the spill was reported, a Coast Guard helicopter, en route to St. Croix, Virgin Islands, observed dark oil in the water off Cabo San Juan. An investigation determined that an estimated **11,000 barrels spilled** from the *Peck Slip*. The Captain of the Port (COTP) San Juan, Puerto Rico, was designated as On-Scene Coordinator (OSC). Sun Oil Company assumed responsibility for the incident and contracted Muratti Construction Company and Crowley Environmental Services for cleanup operations. The Clean Caribbean Co-op was activated by Sun Oil Company. Cleanup operations were directed by the Sun Oil Company until December 29, when the OSC assumed control. Operations ended on January 19, 1979.

Behavior of Oil:

Bunker C fuel oil is a heavy product with an API gravity that ranges from 7 to 14. Observers from the MSO San Juan on a helicopter overflight in the afternoon of December 20 saw heavy concentrations of oil in the water from U.S. Naval Station Roosevelt Roads to Luquillo Beach. Heavy concentrations of oil came ashore at Isleta Marina, Fajardo Beach, Fajardo Ferry Terminal, U.S. Naval Station, Roosevelt Roads, Luquillo Beach, and Yabucoa Harbor. Ramos Island, Rio Mar Beach, Isla Pinero, Isla Careza de Perro, Punta Puerca, and Mosquito Island were also oiled to lesser degree. ***Mangroves*** east of

Punta Medio Mundo were oiled. On December 30, a 5 mile long sheen was observed north of Luquillo Beach.

Countermeasures and Mitigation:

Sun Oil Company requested permission from the Environmental Protection Agency (EPA) to use Corexit 9527 on the offshore oil. The request was routed to the Regional Response Team (RRT) which denied permission. The GST arrived at the MSO San Juan late in the night of December 20. An overflight was conducted early the next day with the OSC, GST, Environmental Protection Agency (EPA), and USCG personnel. On December 21, a command post was established at Fajardo, Puerto Rico, and cleanup operations began. Cleanup operations were conducted by Muratti Construction Company at Yabucoa Harbor, Isleta Marina, Fajardo Beach, and Fajardo Ferry Terminal, and preventive booming was done at Villa Marina. Crowley Environmental Services assisted in the operations at Isleta Marina. U.S. Naval Station Roosevelt Roads cleanup operations were conducted by U.S. Navy personnel who deployed boom as a precautionary measure upon being notified by the USCG of imminent impacts of oil.

On December 27, a Landing Craft Medium (LCM) skimmer removed debris from Ramos Island. On December 28, cleaning of bulkheads at Isleta Marina was attempted with *high-pressure water washing* but with no success. On Ramos Island, Islet Marina, and in the Fajardo area cleanup was complete except for removal of oiled debris. *Boom* was deployed in Yabucoa Harbor, and a *JBF skimmer* collected sheen. Operations continued at Rio Mar with manual labor and heavy equipment, and areas that had begun leaching oil were cleaned with *sorbents*.

On December 29, Sun Oil Company relinquished control of the cleanup operations and the *OSC federalized the spill*. Increased wave action from December 30 to 31 dispersed much of the oil that remained after cleanup operations. On January 1, the OSC determined that additional cleanup would do more damage than good, and released all cleanup contractors. Removal of oiled debris by Sun Oil Company contractors continued until January 3, at which time the OSC concluded the response. Periodic surveys of beaches continued until January 19, 1977.

Other Special Interest Issues:

At a December 22 RRT meeting, the OSC expressed concern with the lack of organization in Sun Oil Company's response to the spill. Inspections by OSC representatives revealed that response equipment and personnel were not being used effectively. At Villa Marina there was no supervisor of the contracted labor, a boom was deployed unnecessarily, and of three vacuum trucks at the site, only one was in use, and that one was being used improperly. At Fajardo Beach there were too many workers for the amount of cleanup needed, and a boom was unnecessarily deployed. When Villa Marina was inspected again by OSC representatives on December 24, the disorganization of the contractors was still evident.

A follow-up field study of two impacted mangrove and sand beach areas was conducted during March and April of 1979. A 0.5 acre area of Red Mangroves suffered total defoliation and mortality within the most heavily oiled area along Puerto Medio Mundo. There was a large reduction in the population of Mangrove Tree Crabs, but tree snails apparently moved out of the area. The only obvious biological effects to sand beach areas were the destruction of supratidal beach plants in a few scattered localities.

References:

- Getter, et al. 1980 Biological Changes of Mangrove and Sand Beach Communities at the Peck Slip Oil Spill Site, Eastern Puerto Rico: Prepared for U.S. Department of Commerce, NOAA. RPI/R/80/2/18-6. 63 pp.
- Hooke, N. Modern Shipping Disasters 1963-1987. Lloyds of London Press. 1987.
- MMS Worldwide Tanker Spill Database
- Robinson, J.H. ed. The Peck Slip Oil Spill. A Preliminary Scientific Report. NOAA Special Report. 1979. Unpublished report.
- U.S. Coast Guard On-Scene Coordinator's Report

Name of Spill: *Presidente Rivera*
Date of Spill (mmddyy): 06/24/89
Location of Spill: Delaware River, South of Marcus Hook, Pennsylvania
Latitude: 39 45 N
Longitude: 075 27 W
Oil Product: No. 6 Oil (heavy industrial grade)
Oil Type: Type 4
Barrels: 7,310
Source of Spill: Tank Vessel
Resources at Risk: Vegetated riverbank, marshes, wading birds, waterfowl, crabs, oysters, commercial fisheries, water intakes.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Closure of commercial fishing areas, unusual or experimental cleanup techniques.
Shoreline Types Impacted: Vegetated riverbanks, marshes, coarse sand beaches, coarse gravel beaches, riprap, tidal mudflat.
Keywords: Atlantic Strike Team (AST), Open Water Oil Containment and Recovery System (OWOCRS), Goodyear boom, Sea Curtain boom, Delaware Bay and River Cooperative, stern trawl net, oil snares, National Guard, Tri-State Bird Rescue Center, Multi Agency Local Response Team (MALRT), vacuum truck, supersucker, skimmer, manual removal, weir/pump skimmer, reoiling, sub-surface oil.

Incident Summary:

On June 24, 1989 at approximately 0500, the Uruguayan motor vessel *Presidente Rivera* ran hard aground in the Delaware River near Claymont, Delaware, south of Marcus Hook, Pennsylvania. The grounding damaged four of the vessel's cargo tanks, resulting in the release of approximately 7,310 barrels of No. 6 oil into the river. The weather at the time was cloudy with occasional thunderstorms, variable light winds, 71°F, and 2-3 miles visibility. The owners of the vessel assumed responsibility and hired a contractor to deploy booms around the ship. Another company was hired as prime contractor for the entire cleanup operation.

Cleanup operations began immediately. By mid-morning of the first day, the vessel had been boomed and lightering operations had commenced. A Multi Agency Local Response Team (MALRT) meeting was held at noon on the first day at the Marine Safety Office (MSO) Philadelphia. By the morning of June 25, the vessel had been refloated and moved to the Sun Oil Co. terminal at Marcus Hook, Pennsylvania for final lightering and inspection. By June 28, there was no significant free-floating oil observed in the river. The vessel was in dry dock in Philadelphia by July 8. Cleanup operations continued into the spring of 1990.

Behavior of Oil:

No. 6 fuel oil is a heavy product with an API gravity that ranges from 7 to 14. The *Presidente Rivera* was carrying over 452,000 barrels of oil at the time of the incident. The No. 6 Oil was heavy and its *pour point was greater than the temperature of the water*. The spilled oil congealed into "pancake" like, tar globs which floated with the river current. *Only 10 percent of the oil was visible above the surface*. The vessel pilot reported to the USCG immediately after the grounding that 1,000 barrels had spilled. An overflight made at first light on June 24 determined that there was considerably more than this amount in the water. At the time of the overflight, the cargo surveyor reported that there were approximately 38,095 barrels of oil unaccounted for based upon tank soundings. Further inspection of the vessel showed that some of the missing oil had drained into previously empty cargo tanks due to internal damage to the bulkheads. *The amount spilled was not accurately determined until 1400 June 27, by which time 21 miles of Pennsylvania and Delaware shoreline had been oiled.*

Due to the varying properties of number 6 oil, it took time to carefully assess the toxicity, specific gravity, and other physical characteristics to ensure an appropriate response. The thick, sticky nature of the product made it very hard to physically remove from both the water and shoreline.

The heaviest shoreline impacts that occurred along the Delaware River were the shoreline and marshes just north and south of the Delaware Memorial Bridge. The marsh area one mile south of the bridge had been heavily impacted on previous spills. There was moderate oiling in the Marcus Hook area and along the Pennsylvania border. The shoreline of New Jersey was only lightly impacted in isolated areas. Approximately 30 miles of the riverbank were oiled in Delaware, Pennsylvania and New Jersey. The impacted beaches were cleaned by July 4, but some were reoiled and had to be cleaned again. By July 24, approximately 85% of the released oil had been recovered.

Of the three states involved, Delaware's natural resources appeared to have been hit the hardest. This included wetlands, blue crab fisheries, and bird populations. Fish populations were generally not affected because of the insolubility of the oil.

Countermeasures and Mitigation:

Booms were placed around the vessel shortly after the grounding occurred. Booms were also placed at the mouths of several area creeks to prevent their contamination. *Eighteen-inch harbor booms were not heavy enough, nor did they extend deep enough to contain oil that was moving with the current.* The oil was entrained with the current and flowed under the boom. The USCG Atlantic Area Strike Team responded to the scene with their *Open Water Oil Containment and Recovery System (OWOCRS)*. This is a 48-inch high seas containment boom with a 27 inch draft. *It was very effective at containing oil against the high currents in the river. Goodyear 36-inch*

inflatable boom was not as effective for this type of oil against the river currents. The same was true with *36-inch Sea Curtain boom* provided by the State of Maryland. It tended to lose most of the oil it had collected after a short time in the river currents. In this incident, better results were obtained with towed boom when moving with the current. This tended to minimize entrainment.

Boom was deployed at the mouths of creeks which drain into extensive marsh areas. These included Oldman's Creek, Raccoon Creek, Naaman Creek, Darby Creek, and the Christina River. There was some difficulty anchoring the booms at the mouths, since there were few firm points on which to anchor the booms. Pea Patch Island received precautionary booming because it is a large nesting area for herons. As a result, Pea Patch Island received only minor oiling. This was quickly removed without any damage to the habitat or wildlife present. Some booms were removed or damaged by recreational boaters in the area. State Marine Police units helped to reduce this problem.

Vacuum trucks were ineffective in removing the oil from the water because of the viscosity of the oil and the amount of oiled debris present. *Supersucker trucks* were able to pick up small chunks of oil, but were generally ineffective because of the lengthy and difficult process of emptying them.

A clamshell bucket and hopper barge were used to remove the oil from the water. This technique worked well and allowed recovery of much of the oil while retaining little water.

Suction skimmers and floating weir skimmers were not efficient because of the tarry consistency of the congealed No. 6 oil. The *Delaware Bay and River Cooperative skimmer Delbay*, a belted inclined plane system, efficiently recovered oil from the river. However, it was unable to use its pumps to discharge the unheated tar-like oil. Thus, its capacity was limited to the size of the collection bay. A *fishing vessel with a stern trawl net* recovered 8 tons of oil and oiled debris from the river. However, the net became so fouled with oil and debris that it could not be used again.

Impacted shoreline was often inaccessible, except by boat. On the riverbanks, cleanup workers used *rakes, shovels, and pitchforks* to remove the oil. Larger chunks of oil collected sand as they rolled along the bottom with the river current and tides. Some of the heavier chunks penetrated into the sand, making their removal much more difficult. During low tide, oil chunks which were stranded on the beach melted in the sun, spreading out as a fluid to cover a large area. *Oil snares* were used in the marshes to clean the marsh grass during the rise and fall of the tide. Once saturated with the heavy oil, the snares were difficult to remove and frequently weighed down the marsh grass.

Other Special Interest Issues:

This spill occurred during a particularly bad time for oil shippers. Within 12 hours, the *World Prodigy* (10,000 barrels spilled in Narragansett Bay, Rhode Island on 23 June), a tank barge (6,000 barrels in the Houston Ship Channel on 24 June), and the *Presidente Rivera* were involved in marine pollution incidents. At the same time, the cleanup of the *Exxon Valdez* spill was still underway in Prince William Sound, Alaska. This put a strain on the oil spill response community, and limited the response personnel and equipment available for this spill.

Within the first two days of the response, it was obvious that there were *not enough personnel on-scene* to undertake cleanup operations adequately. The governors of Pennsylvania and Delaware committed 300 personnel from the *National Guard* to the response. The Guardsmen were utilized for cleanup until three days later when the contractor provided an adequate number of civilian workers for cleanup. Although they were an available supply of personnel, the National Guard troops were not trained in the techniques or hazards inherent with oil spill cleanup.

Bird rescue was performed by the *Tri-State Bird Rescue Center* in Wilmington, Delaware. By July 24, 119 oiled birds had been brought to the Center. As of that date, only nine had died.

Sub-surface oil was detected on crabs and crab pots by July 1. Blue crab fishing was banned in the area from the Delaware/Pennsylvania state line to Pea Patch Island. Crab pot surveys in this area showed approximately 22% of the catch having some amount of oiling. The ban continued through July 26.

References:

- Corcoran, L. and Wiltshire, G.A. 1991. Response to the Presidente Rivera Major Oil Spill, Delaware River, Oil Spill Conference Proceedings, 1991, pp. 253-258.
- NOAA Response Report
- Tanker Advisory Center, Inc. 1991 Guide for the Selection of Tankers. T.A.C. Inc. 1991.
- USCG On-Scene Coordinator's Report

Name of Spill: *Puerto Rican*

Date of Spill (mmddyy): 10/31/84

Location of Spill: San Francisco Bay, California

Latitude: 37 30 N

Longitude: 123 02 W

Oil Product: Lube Oil, Lube Oil Additives, Bunker Fuel

Oil Type: Type 3, Type 3, Type 4

Barrels: 38,500

Source of Spill: Tank Vessel

Resources at Risk: Kelp, wading birds, coastal diving birds, waterfowl, shorebirds, gulls, petrels, clams, oysters, anadromous fish, kelp spawners, salmon harvesting area, commercial fisheries, high use recreational fishing areas, seal concentration area, sea lion concentration area, whale migration route, Point Reyes National Seashore, Point Reyes/Farallon Islands Marine Sanctuary, Duxbury Reef, J.V. Fitzgerald Reserve.

Dispersants: Yes

Bioremediation: No

In-situ Burning: No

Other Special Interest: Adverse weather conditions, wildlife impacts, wildlife rehabilitation.

Shoreline Types Impacted: Sand/gravel beaches, eelgrass beds, kelp, exposed rocky shores.

Keywords: Corexit 9527, U.S. Navy Superintendent of Salvage (NAVSUPSALV), Pacific Strike Team (PST), Open Water Oil Containment and Recovery System (OWOCS), boom, absorbents, vacuum truck, Intervention on the High Seas Act, International Bird Rescue and Research Center (IBRRC), fire, explosion, sinking.

Incident Summary:

On October 31, 1984, at 0324, an explosion occurred on board the Tank Vessel *Puerto Rican* outside the San Francisco Bay Entrance Channel. The vessel was loaded with **91,984 barrels of lube oil and lube oil additives** and **8,500 barrels of bunker fuel**. Two crewmen and the pilot from the vessel were thrown into the water by the blast. The pilot and one crewman were recovered with serious burns. One crewman remained missing and was presumed dead after an extensive search. The explosion caused a relatively minor release of oil. Flames from the initial and subsequent explosions shot as high as 1,000 feet into the sky. The fires on board the vessel were extinguished by late afternoon on November 1.

Following the explosion, the USCG On-Scene Coordinator (OSC) ordered the vessel towed out of the vicinity of San Francisco Bay. The intent of the order was to minimize the potential for catastrophic environmental effect from a massive release of oil. On the basis of trajectory forecasts, the National Oceanic and Atmospheric Administration (NOAA) recommended that the vessel be towed to the vicinity of a nearby ocean dumping site (37 32 N, 122 59 W). This position is at the continental shelf break, 10 miles SE of the Farallon Islands. *The ongoing firefighting and cooling efforts were hampered as the vessel moved farther from shore.*

The weather worsened on November 2, with seas as high as 16 feet and wind speeds up to 35 knots. Salvage and inspection activities ceased for the day. On November 3 at 0000, the *Puerto Rican* broke in two, releasing 25,000-35,000 barrels of its cargo and an undetermined amount of the 8,500 barrels of bunker fuel onboard. The stern section sank one mile inside the boundary of the Point Reyes/Farallon Islands National Marine Sanctuary, taking most of the 8,500 barrels of bunker fuel with it.

Keystone Shipping Co. of Philadelphia immediately assumed financial responsibility for the cleanup. They maintained responsibility throughout the response.

From November 3-18, personnel from the USCG, NOAA, the U.S. Environmental Protection Agency (EPA), the State of California, and numerous contractors and volunteers were involved with the response. On November 18, the forebody of the *Puerto Rican* was towed into the San Francisco Bay for repairs.

Behavior of Oil:

Bunker fuel oil is a heavy product with an API gravity that ranges from 7 to 14. During the towing operation, and as the vessel held position at the continental shelf break, oil was leaking and forming a slick and sheen. Eight to twelve foot seas prevented the *Clean Bay* skimmer from recovering this oil. Less than 1,000 barrels was estimated to be in the water at this time. Weather and sea conditions prevented mechanical removal of the oil and worked to naturally dissipate it. Approval of dispersant use was not sought at this time.

Skimmers were used to collect the oil at sea. The *USCG Pacific Strike Team* brought skimming barrier, *Open Water Oil Containment and Recovery System (OWOCRS)*, to the scene. Weather delayed the deployment of the OWOCRS until it was no longer required.

Countermeasures and Mitigation:

A sheen and narrow slick of light mustard-brown oil were observed trailing from the vessel as it was towed. The skimmer *Mr Clean II* took up a position behind the tanker and began recovering the oil.

When the vessel broke up, the Number 6 center independent tank floated free of the forebody and stern. The stern sank approximately one hour later. The OSC felt that most of the 8,500 barrels of bunker oil went down with this section. The breakup of the vessel released an estimated 25,000-35,000 barrels of the cargo oil into the water approximately 25 miles west of the coast. The weather conditions in the early morning prevented skimmers and barges from reaching the vessel to begin recovery and offloading operations. Clean Bay personnel advised the OSC that dispersant use was the only available alternative under these circumstances.

At 0600 on November 3, EPA and the California Department of Fish and Game (CD F&G) approved the OSC's request for dispersant application. There was some delay because wind and wave conditions prevented a vessel from reaching the scene to take samples which was required by the Regional Contingency Plan. At 1504, a Globe Air DC-4, which had been standing by since shortly after the initial explosion, began the application of *1,958 gallons of Corexit 9527*. Dispersant was applied to 413 acres of the main body of the spilled oil. The application was monitored by Clean Bay, EPA, and the CD F&G.

On November 4, the OSC decided against a second application of dispersants based upon new trajectory forecasts and the observed movement of the oil. At this time, the oil was not predicted to make landfall. The OSC ordered the towing vessel to remain at sea and not to attempt bringing the forebody into San Francisco Bay until the company's salvage plan was approved.

Oil impacted the beaches in Bodega Bay and along the rocky shoreline from Bodega Head to Salmon Creek. Oil concentration was generally light, usually consisting of a yellowish foam in the surf line. By November 14, the beaches and ocean to the north of Point Reyes were reported to be clear, and cleanup operations in Bodega Bay were nearly completed. On November 16, personnel on an overflight reported no visible oil on the coastline from Point Reyes to Fort Bragg, and observed a sheen at the location of the sunken stern section.

Beach cleanup consisted of *deflection boom, absorbents, and vacuum trucks*. Workers were unable to place containment boom across the mouths of many of the bays due to the swift currents. Deflection booms and absorbent booms were placed at the entrances to the harbors. On November 10, deflection booms were deployed at the entrance to Bodega Bay Harbor. *Marco skimmers* were used inside the harbor to recover oil that the booms failed to contain. Skimmers were also used to the south of Point Reyes. These vessels were provided and operated by personnel from the *U.S. Navy Supervisor of Salvage (NAVSUPSALV)*. Skimmers collected about 1,500 barrels of oil-water emulsion, about 2 to 3 percent of the amount spilled.

On November 18, following USCG OSC approval, the forebody of the vessel was brought into San Francisco Bay. It was escorted by firefighting equipment, a USCG cutter, and skimmer, as well as several towing vessels. No leakage was observed during the towing operation. The procession was met at the Golden Gate Bridge by several additional escort vessels and aircraft. The transit to Graving Dock 3 at Triple A Shipyard proceeded without incident. By 2100 the forebody was docked and completely isolated from the waters of San Francisco Bay.

Other Special Interest Issues:

The Coast Guard Marine Safety Office (MSO) requested the broadcast of a notice to mariners warning vessels in the region of the slick, the free-floating independent tank, and the sunken stern section.

The results of the dispersant use were inconclusive. Most agreed that some dispersing action took place, but there was disagreement on the degree of dispersion or the relative success of the whole operation. Observers on an overflight on the day following the dispersant application estimated a range of none, to 20 to 30 percent dispersed.

The offshore location for placement of the vessel suggested to the OSC by NOAA fell outside the jurisdiction of the Captain of the Port. The OSC sought the additional authority to oversee the response under the *Intervention on the High Seas Act*. This act gave the Coast Guard authority to order the owner not to move the stricken vessel closer to shore, and to move it further seaward if it appeared that there was a danger of sinking.

The most seriously impacted natural resources were birds. Bird rescue was coordinated by the *International Bird Rescue and Research Center* and the *Point Reyes Bird Observatory*. These groups reported that a total of 1,320 affected birds were observed, and that 1,013 of these were mortalities. Of the 620 birds brought to the IBRRC for cleaning, 307 died. Point Reyes Bird Observatory personnel estimated that the total mortality of birds, including those which died at sea, could have been as high as 5,000.

Personnel from the Point Reyes Bird Observatory reported observing 15 elephant seals with oil splotches, some of which were heavily oiled. No immediately observed effects to the mammals were noted.

References:

- Clean Bay's Response to the "Puerto Rican" Spill
- Golob's 1978-1989 US Spill Report
- Hooke, N. Modern Shipping Disasters 1963-1987. Lloyds of London Press. 1987.
- MMS Worldwide Tanker Spill Database
- National Research Council. 1989. Using Oil Spill Dispersants on the Sea. National Academy Press, Washington, D.C. 335pp.
- NOAA, Scientific Support Coordinator's report.
- OSIR Oil Spills, International Summary & Review, 1982-1985
- Tanker Advisory Center, Inc. 1991 Guide for the Selection of Tankers. T.A.C. Inc. 1991.
- USCG Federal On-Scene Coordinator's Report
- World Information Systems. 1991. Tanker Losses in U.S. Waters: 1978-1990. World Information Systems.

Name of Spill: Rockaway Fuel Oil Spill
Date of Spill (mmddyy): 07/31/78
Location of Spill: Rockaway Point, New York
Latitude: 40 32 N
Longitude: 073 56 W
Oil Product: No. 6 Fuel Oil, No. 2 Fuel Oil
Oil Type: Type 4, Type 2
Barrels: 1,000
Source of Spill: Non-Tank Vessel
Resources at Risk: Beaches, recreational boating areas, Wildlife Preserve, gulls, terns.
Dispersants: Yes
Bioremediation: No
In-situ Burning: No
Other Special Interest: Complex salvage operations, logistical or operational problems.
Shoreline Types Impacted: exposed fine sand beaches.
Keywords: Containment boom, salvage, skimmer, vacuum truck, Open Water Oil Containment System (OWOCS), boom, Navy boom, Goodyear boom, Bennett boom.

Incident Summary:

On July 31, 1978, the dredge *Pennsylvania* and its tug *Gracie Moran* ran aground while entering Rockaway Inlet, New York under heavy weather. The tug managed to free itself, but the dredge sank in 30 feet of water. The *Pennsylvania* was carrying 140 barrels of No. 2 oil and 880 barrels of No. 6 oil. Oil continued to leak from the vessel until August 7. A number of birds were oiled and recovered. Oil came ashore at beaches at Coney Island, New York; Rockaway, New York; and in lesser amounts at Sandy Hook, New Jersey.

Behavior of Oil:

No. 6 fuel oil is a heavy product with an API gravity that ranges from 7 to 14. No. 2 heating oil has a minimum API gravity of 30, and a pour point between -6 and -27 degrees C. An oil slick measuring 2 miles long by 200 yards wide composed mostly of sheen was observed emanating from the wreck site on the afternoon of July 31. Most of the oil leaked out of the dredge in the first 24 hours. Oil reached Coney Island beaches and Manhattan Beach by August 2. On August 3, Rockaway beaches were impacted, and oil was discovered at Jacob Riis Park and Manasquam Inlet on August 4. As of August 5, oil was leaking out of the vessel at a rate of 1-2 barrels per day. By August 7, the United States Coast Guard Atlantic Strike Team (AST) reported that no new oil was coming from the dredge.

Countermeasures and Mitigation:

The owner of the dredge *Pennsylvania*, The American Dredge Company, assumed responsibility, and contracted Clean Ventures, Inc. to clean up the spill. Clean Ventures arrived on-scene on July 31. The On-Scene Coordinator (OSC) was the Captain of the Port (COTP) New York. A system of anchors and buoys was deployed around the wreck site to which booms were attached. Booming of Sheeps Head Bay, Jamaica Bay, and Gerritsen Inlet was completed early on August 1. Rough weather and powerful currents at the grounding site made deployment and maintenance of booms, and diving operations difficult throughout the incident.

The OSC activated the AST on July 31. They arrived on-scene early the next day, and deployed the Open Water Oil Containment System (OWOCS), but the barrier was not long enough to completely encircle the dredge. Diving operations by the AST and commercial divers beginning on the morning of August 1 revealed that No. 6 oil was leaking from tank vents and that oil was trapped in various parts of the dredge. Information about the piping layout of the vessel, necessary to locate and control leaking vents, was difficult to obtain. Clean Ventures, Inc. attempted to use a *vacuum truck deployed on a landing craft in the recovery operations*. This arrangement proved to be of *limited use* due to the unseaworthiness of the craft, and the need to reconfigure the boom for this operation.

A decision was made on August 1 by the Department of Parks and Recreation to *berm those beaches which might have impacts*. Eventually, the oil would impact parts of the Coney Island beaches, 3.5 miles of the Rockaway beaches, and, in very small amounts, Sandy Hook, New Jersey. The New York beaches were closed for a short time while cleanup operations were conducted.

A Navy JBF skimmer and a belt-type Bennett skimmer were brought on-scene on August 1 and were deployed the next day. Both skimmers suffered immediate mechanical difficulties. Eventually, the *Bennett skimmer proved effective*, but the *JBF was not suited for the heavy seas*. *Helicopters efficiently directed the deployment of the skimmers*. Early on August 2, the OWOCS fouled on the vessel. The day was spent in redeploying the OWOCS and deploying a contractor supplied Bennett boom while diving operations continued. The *Bennett boom proved ineffective* due to entrainment of the oil under the barrier and its inability to withstand the heavy seas. Boom deployed at Gerritsen Inlet had to be redeployed as well. Impacted beaches on Coney Island were cleaned on this day. *One thousand feet of Goodyear boom* arrived on-scene the evening of August 2.

On August 3, the OWOCS was redeployed and Goodyear boom was deployed outside the OWOCS. On August 4, the Goodyear boom was found tangled on the *Pennsylvania*. The Goodyear boom was redeployed, but the OWOCS was retired.

The OSC received *permission to use dispersants*, and an EPA vessel was deployed to apply Corexit 9257 on the spilled oil. The EPA vessel broke down en route, so a Coast Guard 32-foot Ports and Waterways boat was used to apply dispersant throughout the day under EPA supervision.

By August 5, an American Dredge contractor finished removing the remaining recoverable oil from the dredge. The Goodyear boom was attached to heavier anchors deployed by the CGC *Sassafrass* to prevent the boom from dragging onto the vessel again. Navy boom arrived at the site and was deployed inside the Rockaway Inlet near the Marine Parkway Bridge as a preventive measure. Dispersant operations continued on this day. On the afternoon of August 6, the Goodyear boom around the dredge came apart and several hours were spent reconnecting it. The AST verified that the tanks were empty and suggested that dispersants be added to the oil which was trapped in various parts of the dredge. The EPA approved the use of dispersants in the vessel and plans were made to begin the next day. Meanwhile, surface dispersant operations were conducted around the wreck site throughout the day. Dispersants were applied in the vessel and on the surrounding waters on August 7 and 8.

On August 8, the OSC took over the spill, skimmer operations ceased, and the boom in the Rockaway Inlet was taken down. The AST was released on August 10. On August 14, another application of dispersants was made as more oil was observed near the vessel. A total of 288 gallons of dispersant was used by the close of operations. On August 15, the Goodyear boom was removed from around the *Pennsylvania* and the OSC closed the incident. The wreck site was monitored until the salvage of the dredge was complete. Ultimately, 225 barrels of oil were recovered, and 775 barrels were lost.

The USFWS established a center for receiving oiled birds at Breezy Point on August 3. Approximately 500 oiled gulls and 24 oiled terns were recovered in Jamaica Bay.

Other Special Interest Issues:

Although the American Dredge Company initially assumed responsibility for the incident, they never sent a representative to the spill site. This caused problems for the OSC in coordinating the cleanup contractor's activities. Heavy seas and strong currents at the site caused failure of booms and difficulties in diving operations. Containment booms around the barge failed constantly. Increasingly durable booms and heavier moorings were required through the course of the cleanup. Of the four different kinds of boom used at this incident, *Goodyear boom proved more effective than the OWOCS, Bennett boom, or Navy boom.*

References:

- USCG Pollution Incident Case Analysis, unpublished report, USCGHQ.

Name of Spill: *Ryuyo Maru No. 2*
Date of Spill (mmddyy): 11/08/79
Location of Spill: Village Cove, St. Paul Island, Bering Sea, Alaska
Latitude: 57 10 N
Longitude: 170 20 W
Oil Product: No. 2 Fuel Oil
Oil Type: Type 2
Barrels: 6,190
Source of Spill: Non-Tank Vessel
Resources at Risk: Seals, migratory waterfowl, Eider Ducks, arthropods.
Dispersants: No
Bioremediation: No
In-situ Burning: Yes
Other Special Interest: Logistical or operational problems, unusual or experimental cleanup techniques, adverse weather conditions.
Shoreline Types Impacted: Exposed rocky shores, vertical rocky shores, coarse gravel beaches, marshes.
Keywords: Pacific Strike Team (PST), U. S. Naval Explosive Ordinance Detachment (EOD), Crowley Environmental Services, adverse weather conditions, manual removal, sorbents, boom, low pressure washing, demolition, toxic fumes, remote response.

Incident Summary:

On November 8, 1979, the fishing vessel *Ryuyo Maru No. 2* grounded in 60-knot winds and 30-foot seas in Village Cove, St. Paul Island, Bering Sea, Alaska. The vessel initially spilled about 950 barrels of light oil and continued to leak for the duration of the incident. An initial survey found nine of 12 tanks holed. The ship's refrigeration system failed, releasing toxic levels of ammonia gas in the interior. Access to the vessel was complicated by the rough seas and a 200-foot high cliff at the grounding site. A makeshift, 90-foot highline was rigged from the base of the cliff to the ship. The only alternative mode of access was by helicopter, which was not always available because of weather.

The Commanding Officer, Marine Safety Office (MSO), Anchorage, the predesignated On-Scene Coordinator (OSC) for the spill, sent a representative to the site on November 9. The owners of the vessel initially assumed responsibility for cleanup operations, but abandoned their responsibility on November 15, at which time the OSC took full control of the spill response. Explosives were used to vent dangerous accumulations of ammonia gas on November 20, and also to finally destroy the vessel on November 22. The response ended on December 5.

Behavior of Oil:

No. 2 fuel oil has a minimum API gravity of 30, and a pour point between -6 and -27 degrees C. Initial reports from the LORAN Station on St. Paul indicated broken patches of oil in the water extending around Tolstoi Point and into seal rookeries. The oil was breaking up and dissipating in heavy weather with seas in excess of 20 feet. Village Cove and the saltwater lagoon connected to it were heavily oiled. Sheen and emulsified oil were found in Village Cove, Zoltoi Bay, and English Bay. Oil continued to leak from the vessel until November 22, when the vessel was destroyed. Much of the oil burned within the hulk and the remainder moved out to sea.

Countermeasures and Mitigation:

The owners of the vessel hired Crowley Environmental Services (CES) to conduct cleanup operations. The Pacific Strike Team (PST) and CES arrived on scene on November 10. Alaska Department of Environmental Conservation personnel and Environmental Protection Agency personnel began beach surveys on the afternoon of November 10.

The shoreline at the site of the grounding was exposed to extremely high wave energy so that no cleanup activities were needed except for removal of oil soaked debris. The northern edge of Village Cove is a shallow, saltwater lagoon. The initial release of oil killed 50 percent of the arthropods in the lagoon. To protect seals and waterfowl, and to minimize further damage to the lagoon's ecology, booming of the lagoon entrance was attempted. However, the 5- to 10-knot currents in the entrance caused entrainment of oil and physical damage to the booms. An attempt was made to build a dam across the entrance to the lagoon. This caused severe scouring at the bottom of the channel as the dam neared completion, and the project was abandoned. A sandbag dike was built with an attached boom to deflect oil into a pit dug in the shore near the dike. Wind action helped collect the oil entering the edge of the lagoon where it was recovered with absorbent materials. Oiled shoreline in the lagoon was cleaned by manual removal using sorbents. Low-pressure washing of beaches and grassy areas, and hazing operations to scare birds from the oiled areas began on November 18.

Five options were considered to deal with the situation, including:

- pumping oil from the ship to bladders on LCMs (Landing Craft Medium)
- bringing an ocean-type tank barge to the scene from Seattle for the oil transfer
- removal of the ship using expanding foam
- pumping the oil to the top of the cliff
- destruction of the vessel at a time when the weather would disperse it.

Destruction of the vessel was the option chosen. On November 22, personnel from the United States Naval Explosive Ordnance Detachment (EOD) and the Coast Guard destroyed the vessel by demolition. Thermal grenades were also

used to ignite the oil and the nets which could not be removed from the vessel. The slick resulting from the destruction of the vessel moved out to sea and dissipated. Some of the 300 tons of fish and the fishing nets from the vessel came ashore after the explosion, and were cleaned up.

Other Special Interest Issues:

Between 10,000 and 20,000 seals inhabit St. Paul Island between April and November. Dead oiled seals were observed in the rookeries, but it was not known if the oiling caused these deaths or not; high mortalities are normal during this season. Fishing nets washed off the *Ryuyo Maru* caused additional mortality when seals become trapped in them. Dead, oiled birds were found; both seals and birds were killed by the concussion of explosives.

Lack of housing and food for the response personnel and the personnel from the *Ryuyo Maru No. 2* caused logistical and operational problems. Equipment for the spill response, especially transportation and fuel for the response personnel was in scarce supply on the island. Equipment and supplies had to be transported in from remote locations, making operations very difficult.

The *Ryuyo Maru No. 2*'s refrigeration system ruptured during the grounding, and released ammonia into the vessel. It was impossible to locate and seal the source of the leak because no self-contained breathing apparatus units were initially available.

The vessel was inaccessible for lightering or salvaging operations because of extremely heavy weather. Storms, high winds, and cold temperatures allowed only minimal work to be done on many days.

References:

- Reiter, G. Cold Weather Response F/V Ryuyo Maru No.2 St. Paul, Pribilof Islands, Alaska, Oil Spill Conference Proceedings, 1981, pp. 227-231.
- USCG On-Scene Coordinator's Report

Name of Spill: *Sanko Harvest*
Date of Spill (mmddyy): 02/13/91
Location of Spill: Esperance, Western Australia
Latitude: 34 10 S
Longitude: 122 30 E
Oil Product: Fuel Oil
Oil Type: Type 2
Barrels: 4,400
Source of Spill: Non-Tank Vessel
Resources at Risk: Seals, birds, beaches, national parks.
Dispersants: Yes
Bioremediation: No
In-situ Burning: No
Other Special Interest: Adverse weather conditions, wildlife impacts.
Shoreline Types Impacted: Fine sand beaches, coarse sand beaches.
Keywords: Sorbents, sinking, International Tanker Owners Pollution Federation (ITOPF), Corexit 9527

Incident Summary:

On the night of February 13, 1991, the Panamanian bulk cargo carrier *Sanko Harvest* grounded on a submerged rock pinnacle 23 miles south of Esperance, Western Australia. The vessel, out of the shipping lane at the time of the incident, was loaded with 30,000 metric tons of fertilizer, diammonium phosphate, and triple superphosphate. The double hull of the vessel was ripped open in the grounding and the freighter began leaking its fuel oil. On February 18, the ship broke in two in a storm and sank with its entire cargo and bunker fuel. Approximately 3,500 barrels of fuel oil were spilled during the incident. The remaining 900 barrels of oil sank with the ship.

Behavior of Oil:

The spilled oil initially created a slick approximately 2 miles long and 1000 feet wide. As the slick grew to 9 miles long, it began to threaten nearby islands. Approximately 2,100 barrels of the fuel oil came ashore along 17 miles of the northeast islands and the mainland of Australia. The worst of the oiling was on beaches to the west of Esperance, particularly Hellfire Bay, Thistle Bay, Lucky Bay, and Rossiter Bay. Oil sank into these coarse-grained beaches to a depth of approximately one-half inch. The incident occurred approximately six miles from Cape Le Grand, which is east of Esperance, and the beach at Cape Le Grand National Park also received heavy oiling. On the beaches with fine-grained sand, the oil did not penetrate the tightly compacted beach sand, and was deposited on top.

Countermeasures and Mitigation:

The *Department of Marine and Harbors (DMH)* deployed nearly 1,700 feet of Expandi containment boom around the ship in two rows. The sea and wind conditions at the time were very rough. More than two-thirds of the boom was damaged at sea and lost. Less than one-fifth of the deployed boom was recovered and cleaned enough to be reused.

The primary response tool was *chemical dispersant spraying*. Dispersants were used in limited amounts to lessen environmental effects. Twenty-two 200-liter drums of dispersant were sprayed on parts of the slick from helicopters and tugboats. *BP A-B*, used in the surf zone, and *Ardrox 6120*, described as similar to *Corexit 9527*, were sprayed on the oil during the week long response. The spraying reportedly dispersed approximately 700 barrels of the spilled oil.

Sorbents were used to clean the beaches to the west of Esperance, which were reportedly only moderately oiled. Mechanical cleanup was performed on the heavily impacted beaches at Cape Le Grand National Park and Lucky Bay. This included the use of graders and front-end loaders to remove the oiled debris. Lightly oiled beaches were rapidly cleaned naturally along the high energy coastal environment.

Many of the oiled sites east of Esperance were difficult for cleanup personnel and equipment to reach. Contractors and volunteers manually cleaned the very fine sand beaches by scraping off the oiled sand, since the oil did not penetrate deeply into the beach in these areas. A substantial amount of oiled sand was placed in a gravel pit near Lucky Bay. The oil penetrated into the coarser sand beaches. Tarballs of stranded oil were reported on the beaches.

Other Special Interest Issues:

An unknown number of birds were killed as a result of the spill. The oil also impacted Hood Island and Seal Rock which were important breeding grounds for New Zealand fur seals. A team from the Australian *Department of Conservation and Land Management (CALM)* worked to save the affected colony. Between 11 and 200 seal pups were reportedly oiled on Hood Island and Seal Rock. The team, made up of scientists and volunteers, went to the islands and cleaned the oiled pups on-scene using a simple detergent, CT 18, and a laundry stain remover, Preen, to remove the residual oil and detergent. There was only one reported seal pup death.

References:

- Freighter Breaks Up and Spills 600 Metric Tons of Fuel Oil Off Western Australia. Golob's Oil Pollution Bulletin. 01 March 1991.
- Genwest Systems, Inc. communications with ITOPF representatives.
- Oil Spill Threat to New Zealand Fur Seals. Marine Pollution Bulletin. Vol. 22. No. 4. April 1991. p. 166.
- Panamanian Ship Sinks in Uncharted Australian Waters. Oil Spill Intelligence Report. 28 February 1991. pp. 3-4.

Name of Spill: *Sansinena*
Date of Spill (mmddyy): 12/17/76
Location of Spill: Los Angeles Harbor, California
Latitude: 33 43 N
Longitude: 118 16 W
Oil Product: Bunker C
Oil Type: Type 4
Barrels: 30,000
Source of Spill: Tank Vessel, pipeline.
Resources at Risk: Gulls, mussels, crabs, marinas, boat ramps, beaches.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Complex salvage operations, research conducted, unusual or experimental cleanup techniques.
Shoreline Types Impacted: Piers, sand/gravel beaches, developed upland.
Keywords: Boom, manual removal, self-contained skimming devices, sorbent pads, sub-surface oil, suction operations, fire, explosion, sinking.

Incident Summary:

At 1938 on December 17, 1976, the *Sansinena* exploded, caught fire, and sank during refueling at the Union Oil Terminal, Berth 46, in Los Angeles Harbor, California. The vessel was loaded with 22,000 barrels of Bunker C at the time of the incident. The apparent cause was a still-air situation that developed between the mid-ship house and the afterdeck house. Vapors emitting from the cargo tank vents created a vapor cloud during ballasting. These were ignited in the midship house and flashed back through the vent piping system. The largest explosion took place in the number 10 center cargo tank. The force of the explosion propelled the main deck over the cargo tanks into the air. When the deck landed, it severed a 36-inch cargo line on top of the inshore isolation valve. This severed line fed fuel to the fire until response personnel discovered and capped it on December 21. Nine lives were lost as a result of the explosion. Debris and oil scattered in all directions. Approximately 400 boats in the vicinity were damaged by the fine mist of airborne oil, resulting in millions of dollars in property damage. An estimated 30,000 barrels of oil were released into Los Angeles harbor from the ship and the severed pipeline.

A U.S. Coast Guard boat and a Los Angeles City Fire Department boat arrived on-scene within five minutes of the explosion to assist in firefighting and rescue operations. Pollution surveys were conducted after the fire was under control. Initial reports concluded that much of the oil had burned off, but on December 19, underwater divers discovered a *large quantity of oil on the bottom of the harbor*. The primary cleanup contractors were IT Corporation, Crowley Environmental Services, Crosby & Overton, Inc., and Fred Devine Diving and Salvage, Inc. Boom deployment began within two hours of the explosion. Boom and other containment gear were utilized for the next 120 days, while mechanical removal of oil from the bottom of the harbor

continued for 16 months. Total oil removal costs exceeded three million dollars.

Behavior of Oil:

Bunker C fuel oil is a heavy product with an API gravity that ranges from 7 to 14. The lighter, more toxic fractions of oil burned on the surface of the water following the explosion. The *remaining thick residue sank to the bottom of the harbor* in approximately 50 feet of water.

On December 21, USCG Pacific Strike Team (PST) and Parker Diving Service divers conducted an underwater survey of the harbor. They found large pools of oil on the harbor floor and in the lower portions of the cargo tanks resting on the bottom. The pools of oil, up to nine feet deep, had settled into hard, clay packed pockets and crevices along the bottom.

By January 17, 1977, the amount of grease and oil on the surface of the water had increased and was greatest in the slip area and shallow beach area to the northwest and west of the spill site. In July 1977, grease and oil levels in the water column rose slightly while levels in the sediments decreased. The total amount of retrieved oil from the surface and the bottom of the harbor was 33,000 barrels, partly as an oil/water emulsion.

Countermeasures and Mitigation:

The first boom deployed consisted of 2,000 feet of *8-inch skirted harbor boom* in a reverse "J" configuration from the bow of the vessel to 1,000 feet off her port beam. The boom contained a large portion of the floating oil while still allowing emergency and firefighting access to the area. After observing the oil near Cabrillo Beach, the On-Scene Coordinator (OSC) recommended a three phase booming operation. First, large booms were deployed to isolate the entire outer harbor area including Berth 46, Berth 47, the Los Angeles breakwater, and Fort MacArthur. After emergency vessels cleared the area, a second set of boom was deployed to enclose the *Sansinena*. The final set of boom was deployed along the breakwater and Cabrillo Beach area. These placements were selected to isolate the heaviest concentrations of oil along the sides of the outer harbor to enable easier removal of the oil.

Beach areas were cleaned by *manual removal* of oil-soaked sand. This phase of cleanup was completed by December 20. By December 24, all collectable surface crude and diesel oil had been removed with *two self-contained skimming devices* and *sorbent pads*.

A naval architect from Fred Devine Diving and Salvage, Inc., designed the pumping system used to collect oil from the harbor floor. A *two-piece adjustable suction head*, capable of pumping 2 to 4 gallons per minute, was controlled by guy wires aboard a salvage barge. A *hydraulically driven screw-type progressive cavity pump* mounted on top of the suction head was connected to the barge by hydraulic lines. After divers placed and adjusted the head in an oil pocket, the oil was pumped from the bottom and

transferred via a three-inch hose to an oil collection tank mounted on the salvage barge. This oil was then transferred to an on-shore settling tank for disposal. As removal operations continued and pumping became more difficult due to smaller crevices, the suction head had to be redesigned into a configuration with three smaller satellite heads. In sixty days, 10,000 barrels of oil had been removed from the harbor bottom. This design was the first known viable technique to remove heavy, highly viscous oil from the bottom.

Other Special Interest Issues:

Harbors Environmental Projects (HEP) conducted studies on the impact of the spilled oil on biology and water quality at 24 stations in the area. This was the first known Bunker C spill where both pre and post spill biological and water quality data had been collected. This same area had been an HEP research area since 1972. HEP studies revealed that most marine environmental damage was in the intertidal zone of the beach and the breakwater and pilings. Phytoplankton was most heavily impacted during the first month of the spill, while copepod numbers significantly increased in the spill area between January and April. Although small benthic infaunal organisms were heavily impacted about 3-4 months after the spill, the community returned to normal 9 to 11 months after the incident when the residual oil had lost its toxicity.

References:

- Hooke, N. Modern Shipping Disasters 1963-1987. Lloyds of London Press. 1987.
- Hutchinson, J.H. and B.L. Simosen, 1979. Cleanup operations after the 1976 SS Sansinena explosion - An industrial perspective, Oil Spill Conference Proceedings, 1979, pp. 429-433.
- MMS Worldwide Tanker Spill Database
- Soule, D.F. 1980. Evaluation of Impacts of the "Sansinena" Explosion and Bunker C Spill in Los Angeles Harbor, December 1976. Marine Environmental Pollution, 1. Hydrocarbons. Elsevier Oceanography Series, 27A. pp. 497-530.
- The Proceedings of the Conference on Assessment of Ecological Impacts of Oil Spills, 14 - 17 June 1978
- White, W.W. and J.T. Kopeck, 1979. Oil spill control and abatement techniques used at the SS Sansinena explosion site - A Coast Guard perspective, Oil Spill Conference Proceedings, 1979, pp.434-435.

Name of Spill: Santa Barbara Well blowout
Date of Spill (mmddyy): 01/28/69 - 02/07/69
Location of Spill: Santa Barbara, California
Latitude: 34 10 N
Longitude: 119 45 W
Oil Product : California crude oil
Oil Type: Type 4
Barrels: 100,000
Source of Spill: Platform
Resources at Risk: Commercial fisheries, diving coastal birds, shorebirds, seals, sea lions, whales, bird migratory routes, mammal migratory routes, high-use recreational boating area.
Dispersants: Yes
Bioremediation: No
In-situ Burning: No
Other Special Interest: Closure of commercial fishing areas, effects to personal property, effects to recreation areas, volunteer response and organization.
Shoreline Types Impacted: Exposed seawalls, sand/gravel beaches, exposed rocky shores.
Keywords: Polycomplex A, Corexit, straw, high-pressure washing, booms.

Incident Summary:

On January 28, 1969, the Union Oil Company well number 21 under Platform A, located 5.5 miles southeast of Santa Barbara, California, in the Dos Cuadras field, experienced a blowout while drill bits were being changed. A massive mixture of oil, gas, and drilling mud roared up the drill casing and spewed out onto the platform. Well A-21 was capped on February 7 with 13,000 barrels of heavy drilling mud. Oil continued to vent from natural faults several hundred yards from the platform, in tract 4042 between the coast and a chain of islands. The faults released a total of 100,000 barrels of oil until December 1969.

A record-breaking storm immediately before the incident contributed to the large amount of oiled debris that needed to be collected as part of the spill response. On February 2, the National Pollution Contingency Plan, instituted by President Johnson in 1968, went into effect for the first time. The Federal Water Pollution Control Administration was on-scene to monitor the well-killing process and cleanup. Red Adair was brought in to provide expertise capping the well. To aid in predicting the slick movement, the National Weather Service set up a local station to monitor winds and tides. Weather during the cleanup was moderate except for a storm on February 4 and 5 that temporarily halted cleanup by damaging booms that were protecting harbors and marinas.

The majority of the cleanup was completed within 45 days. *Commercial fishing was completely closed in the area from February until April.* Although the environmental effects of the spill were relatively minimal, economic effects were extensive due to loss of fishing income, loss of recreational facilities, and damage to personal property.

Behavior of Oil:

California crude oil is a heavy product with a range of API values between 10.3 and 13.2. During the first few days of the spill, the rate of crude oil release was estimated at 5,000 barrels per day. By March 3, the seepage from the surrounding natural faults had slowed to around 30 barrels per day. The rate then continued to decline to a relatively constant flow of 5-10 barrels per day over the next 2 to 3 months. Although there was no conclusive figure on the total amount of oil released into the water, it was estimated at from 33,000 to 80,000 barrels.

The day of the incident, the oil covered a 25-square mile area east of the platform. On January 31, the oil slick was reported to be 30 square miles with another 200 square miles of lighter fractions between Carpinteria and Santa Barbara. The oil stayed offshore for several days until a shift in the wind pushed a relatively small amount of oil onto the shoreline on February 1. The Rincon surfing area was the first affected beach and the slick in the ocean was 4 miles by 12 miles with lighter fractions extending for 80 square miles. Winds, high tides and surges on February 4 pushed oil onto the beaches directly east and west of Santa Barbara, carrying the oil to seawalls, roads and buildings. The oil slick scattered on February 6, affecting approximately 100 miles of Southern California coastline. Oil was observed onshore at several mainland beaches from Pismo beach down to the Mexican border by March 19. *Approximately 40 miles of coastline from Pismo Beach to Santa Monica was contaminated over the next several months.* Boats and seaside buildings were contaminated with the oil.

Countermeasures and Mitigation:

Dispersants were used up to two miles from the shore. Only low-toxicity dispersants, *Polycomplex A* and *Corexit*, were used.

The predominant beach cleanup method was manual removal.

Approximately 3,000 tons of *straw* were effectively used for beach cleanup. The straw was also dumped offshore to soak up floating oil.

High-pressure water washing, sometimes followed by *sandblasting*, cleaned stains on rocky beaches, seawalls, and breakwaters.

A mixture of *talc* and *naphtha* was used to dissolve the tar-like oil on rocks, seawalls, and the harbor breakwater. A crust of oil and talc would remain after the applied naphtha evaporated. This crust was blasted with high pressure water, causing it to disintegrate into a harmless brown dust.

By February 11, about 18,900 feet of *boom* had been deployed. Booms were not always successful due to their late arrival. Boom placed at the harbor entrance shut down the commercial fishing industry from February until April.

The well was *plugged* with drilling mud and cement on February 7, reducing the leak to small gas bubbles. The natural fault seepage was slowed once the well pumping operations were resumed and *underwater tent collection* begun.

Over 1,000 workers, 54 boats, and 125 pieces of mechanical equipment were used during the cleanup effort. Approximately 5,200 truckloads of oily debris were hauled to several major landfill sites around the Santa Barbara area. Beaches were in use by June 1, though cleanup on rocky shores was not finished until August 15. *The total cost due to cleanup exceeded \$4.5 million.*

Other Special Interest Issues:

This was the worst incident involving an offshore platform to date in the United States. Residents of Santa Barbara were in the midst of a battle to stop drilling in this channel, famous for its active oil seeps, when the accident occurred. Many people felt that not enough attention had been given to the environmental risks associated with drilling in this area. The accident may not have occurred if Union Oil had put steel casing around the hole to a depth of 2,000 feet. Even though this is a known unstable earthquake fault area, Union had received a waiver from Federal officials to case the well to only 238 feet. Media coverage was high and several protests and sit-ins resulted. This incident was also influential in the development of the National Environmental Policy Act, signed by President Nixon on January 1, 1970.

Ventura Humane Society received many of the early reports of oiled birds, mostly gulls and grebes. On February 2, the primary bird treatment center was moved from Carpinteria Beach State Park to the Santa Monica Bird Refuge near Montecito due to traffic jams on Route 101. The birds were dipped in a solution of Polycomplex A in an attempt to dissolve the crude oil without removing the natural oils on their feathers. Volunteers also cleaned birds at the Childs Estate bird center. Approximately 3,700 birds were known to have died as a result of oiling. This number probably represents a small fraction of the total number of bird deaths attributable to this oil spill.

References:

- Cimberg, R., "A Reinvestigation of Southern California Rocky Intertidal Beaches Three and One-Half Years After the 1969 Santa Barbara Oil Spill: A Preliminary Report," Oil Spill Conference Proceedings, 1973, pp. 697-702.
- Dye, L. "Blowout at Platform A." Doubleday & Co. 1971.
- Easton, R.O. Black Tide: The Santa Barbara Oil Spill and its Consequences. Delacourt Press. New York. 1972. 336 pp.
- Gilmore et al. 1970. Systems Study of Oil Spill Cleanup Procedures. Vol.1: Analysis of Oil Spills and Control Measures.
- Gundlach, E. and Marshall, M. 1990. The Physical Persistence of Spilled Oil: An Analysis of Oil Spills Previous to Exxon Valdez. Final Report. HAZMAT. OAD. NOAA. pp.47-68.
- Hoult, D.P. Oil on the Sea. 1969.
- Potter, J. 1973. Disaster By Oil. The Macmillan Company, NY. pp. 153-245.
- The SocioEconomic Impacts of Oil Spills, Final Report, WAPORA, March 1984.
- Wilson, et al. 1976. "The Spreading, Retention and Clean-up of Oil Spills," University of Rhode Island, Kingston, RI.

Name of Spill: Schuylkill River Spill
Date of Spill (mmddyy): 06/22/72
Location of Spill: Douglassville, Pennsylvania
Latitude: 40 15 N
Longitude: 075 38 W
Oil Product: Waste oil and sludge
Oil Type: Type 3
Barrels: 170,000
Source of Spill: Facility
Resources at Risk: Terrestrial mammals, freshwater marshes, drinking water intakes, industrial water intakes.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Human health and safety concerns, logistical or operational problems, adverse weather conditions.
Shoreline Types Impacted: vegetated riverbanks.
Keywords: Boom, filter fence, sorbent granules, National Strike Force (NSF), manual removal.

Incident Summary:

On June 22, 1972, 140,000-190,000 barrels of waste oil and sludge from Berks Associates oil reclamation plant escaped into the Schuylkill River at Douglassville, Pennsylvania. The release resulted from heavy rains and flooding of the entire lagoon complex. Twelve to eighteen inches of rainfall from *Hurricane Agnes* on June 21-22 raised the Schuylkill River 20 feet over its banks and flooded the waste oil lagoons. Agnes proved to be the worst natural disaster in the U.S. at the time. Two billion dollars in damage and 100 fatalities were attributed to the storm.

The spilled oil was not sighted until June 23, due to the more pressing concerns of evacuation and property damage. U.S. Coast Guard and Environmental Protection Agency personnel conducted an overflight of the area to assess the magnitude of the flood damage. *Black oil and several hundred drums containing hazardous chemicals were spread over much of the countryside along the Schuylkill River.* The Regional Response Team (RRT) was assembled and an on-scene coordinator was assigned by the EPA. The National Contingency Plan revolving fund was opened under the "Act of God" provision. On June 28, the Coast Guard National Strike Force and personnel from the Division of Oil and Hazardous Materials (DOHM) were called.

The rains stopped on June 30. The top priorities at this point were to reduce the amount of oil leaching from the lagoons into the river and to protect the water intakes of downstream cities. On July 4, three main contractors, Underwater Technics, Clean Water, and New England Pollution Control were tasked with cleaning up a 16 mile stretch of the Schuylkill River. The spill area became a testing ground for cleanup methods. The bulk of the

cleanup was completed by early August. By the conclusion of operations on September 30, the cleanup bill totaled \$4.5 million.

Behavior of Oil:

As a result of the flood waters overflowing the facility dikes, much of the sludge oil spread over 15 miles of downstream area. The area between Douglassville and Pennhurst was the most heavily oiled. As the rain washed oil from the banks into the river, the resulting slick was carried further downstream. Sticky oil coated fifteen islands in the river. The sticky sludge oil heavily coated many of the buildings, trees, and farmlands in the flood area. Channels cut in facility dikes by the oil and water mixture allowed the continued flow of oil to the flooded areas until June 27.

Evaporation of oil from the foliage and ground was accelerated by warm muggy summer weather. The fumes from the evaporating oil created an explosion and fire hazard. *The sludge was tested by Ocean Science and Engineering and found to contain high concentrations of lead.* Poisoning from contact or drinking contaminated water became an immediate concern due to this unusually high lead content.

Countermeasures and Mitigation:

Industrial water supply intakes at Pottstown, Pennhurst, Black Rock Can and Kenilworth were protected with *deflection boom*. The installation of *filter fences proved ineffective* at containing the oil due to thin sheens that floated down river in the strong currents. Two short sections of *diversion boom* were effectively used to guide surface oil into coves and back waters near Hanover Street Bridge. Thirteen hundred feet of diversion boom installed at Pennhurst successfully captured oil sheen. Collection of oil in natural low spots in farmlands, combined with various active collection methods resulted in the recovery of 8,330 barrels of oil and water mixture. Sludge oil was pumped out of the lagoons at the Berks Associates facility as soon as weather and resources permitted.

During the first six days of the response, *sorbent granules* were generously spread in pools of liquid oil and in areas where oil covered the ground. Granules were also used on low bushes and shrubs with mixed results. *Although sorbent granules stabilized the oily ground, enough to permit walking and vehicle traffic, they also made the oil too thick to recover by vacuum or pump.* Oil and sorbent mix also proved to be a problem with regard to disposal since refineries would not accept recovered product. Widespread use of these sorbents was discontinued on July 7.

Manual raking and shovelling, caused less environmental damage than removal equipment and proved most effective in picking up small debris. *Horses and mules* were used to drag containers of oil and skid pans of debris from inaccessible areas such as the river islands. The animals delivered the debris to boats and scows for offloading. Garden tractors with trailers were also valuable in hauling of debris.

High concentrations of sludge oil that became mixed with collected debris made burning the material inappropriate. The sludge oil contained high residues of lead and other metals. Railroad hopper cars were used to transport the debris to suitable land fill sites. A total of 13,627 tons of oiled debris was collected in 222 hopper cars.

Other Special Interest Issues:

A shortage of response resources was created by other needed rescue and restoration activities from the destruction of Hurricane Agnes. Coordination of efforts and allocation of resources had to be done carefully to cover the prioritized needs as quickly as possible. Damage to water and sewer treatment plants, communications, and power facilities required the most urgent response. The immensity of the cleanup operation also carried with it many problems of funding, public relations, logistics, disposal, sanitary facilities for workers, and communications.

More than 2,000 drums and barrels with of assorted chemicals and oils from various industrial companies lined the riverbed. Hundreds of these drums were reported in West Virginia, along the Potomac River. Some drums were also reported in the Delaware River below Philadelphia. Many of these toxic drums were explosive or gave off poisonous fumes. The Army Corps of Engineers was assigned the job of retrieving and disposing of these drums after CHEMTREC and DOHM identified the contents.

References:

- EPA Report
- Kaiser, et al. 1973. Tropical Storm Agnes Pennsylvania's Torrey Canyon. Oil Spill Conference Proceedings, 1973, pp. 569-577.
- Wilson, M.P. Jr., et al. 1976. "The Spreading, Retention and Clean-up of Oil Spills," URI, Kingston, RI, 1976.

Name of Spill: *Sea Speed Arabia*
Date of Spill (mmddyy): 06/30/79
Location of Spill: New York Upper Harbor, New York
Latitude: 40 40 N
Longitude: 074 11 W
Oil Product: No. 2 Diesel, No. 6 Fuel Oil
Oil Type: Type 2, Type 4
Barrels: 2,857
Source of Spill: Tank Vessel
Resources at Risk: Nesting beaches, wildlife refuge, beaches.
Dispersants: Yes
Bioremediation: No
In-situ Burning: No
Other Special Interest: Effects to recreation areas, effects to tourism, unusual or experimental cleanup techniques.
Shoreline Types Impacted:
Keywords: Boom, skimmer, vacuum truck, Corexit 9527

Incident Summary:

On June 30, 1979, the *Seaspeed Arabia* grounded in the Kill Van Kull off Bayonne, New Jersey. Two port fuel tanks were ruptured and approximately 3,000 barrels of combined No. 2 diesel fuel and No. 6 heavy fuel oil spilled into the New York Upper Harbor. The vessel proceeded to Bethlehem Steel Corporation's dock at the Military Ocean Terminal in Bayonne for repairs.

Behavior of Oil:

No. 6 fuel oil is a heavy product with an API gravity that ranges from 7 to 14. Oil was carried on tidal currents down the Verrazano Narrows. Slicks formed off Staten Island. Approximately 1,190 barrels of oil impacted 2.5 miles of Staten Island beaches. Over 1,600 cubic yards of oiled debris were collected from the beaches.

The oil threatened to impact the Jamaica Bay Wildlife Refuge, which was inhabited by nesting birds at the time. The United States Navy planned to boom the refuge if the oil began to move in that direction. Favorable winds kept the oil from entering the refuge.

Countermeasures and Mitigation:

The vessel's owners assumed responsibility for the spill, and contracted Clean Venture, Inc., AAA Pollution Control, and Coastal Services, Inc. for cleanup and containment operations. The responders used booms to direct the oil towards Staten Island where three self-propelled skimmers supplied by the United States Navy, Clean Ventures, Inc., and Clean Harbors Cooperative collected the oil. Vacuum trucks were also used to recover the oil. As of July 9, approximately 1,084 barrels of oil were recovered from the water. The United States Coast Guard (USCG) constructed berms on the beaches of Coney Island to prevent oiling.

The dispersant *Corexit 9527* was effectively used to disperse the slick off the Staten Island.

Other Special Interest Issues:

The Regional Response Team (RRT) authorized the use of *Corexit 9527* on the spilled oil. Clean Services, Inc. applied 440 gallons of dispersant to the slick under the supervision of the United States Environmental Protection Agency (EPA). The USCG also tested the dispersant *Sea Master NS-555* from Whale Chemical Company, Inc. on the spill. The test showed that the dispersant was effective in breaking up the slick.

Oiled Staten Island beaches were closed to recreation during the July 4 holiday.

References:

- Cleanup Nears Completion in N. Y. Harbor. Oil Spill Intelligence Report. Vol. II, No. 28. July 13, 1979. p.3.
- Grounded Ship Spills 120,000 Gallons in New York Harbor. Oil Spill Intelligence Report. Vol. II, No. 27. July 6, 1979. p.3.
- MMS Worldwide Tanker Spill Database
- World News Briefs. Oil Spill Intelligence Report. Vol. II, No. 29. July 20, 1979. p.3.

Name of Spill: *Sea Spirit*
Date of Spill (mmddyy): 08/06/90
Location of Spill: Strait of Gibraltar
Latitude: 35 53 N
Longitude: 005 58 W
Oil Product: Heavy Fuel Oil (HFO)
Oil Type: Type 4
Barrels: 48,875
Source of Spill: Tank Vessel
Resources at Risk: Beaches, commercial fisheries, fish aquaculture sites, fish, molluscs.
Dispersants: Yes
Bioremediation: No
In-situ Burning: No
Other Special Interest: Closure of commercial fishing areas, effects to recreation areas, effects to tourism.
Shoreline Types Impacted: Sand/gravel beaches, exposed rocky shores.
Keywords: International Tanker Owners Pollution Federation (ITOPF), side-looking airborne radar (SLAR), remote sensing, collision, manual removal, boom, straw.

Incident Summary:

On the evening of August 6, 1990, the Cypriot tanker *Sea Spirit* and the Norwegian Liquefied Petroleum Gas (LPG) carrier *Hesperus* collided in the Strait of Gibraltar. The *Sea Spirit* was holed on the starboard side above and below the waterline, causing approximately 48,875 barrels of oil to be spilled into the Mediterranean Sea. Estimates of the total volume spilled ranged from 48,875 to 89,426 barrels. The bows of the *Hesperus* were destroyed, but the vessel was still capable of sailing and did not leak any of her cargo.

Behavior of Oil:

Prevailing currents drew the oil into the Mediterranean Sea. The oil was caught in the flow of a clockwise gyre between Morocco and Spain and made approximately two to three revolutions in the gyre over the following week, breaking up and dispersing naturally. As the main body of the oil moved in the gyre, it passed within a few miles of the Moroccan coast, near Punta de los Frailes.

The oil spread out with extensive sheen due to the warm, calm conditions at the time. Sheen and large patches of emulsified oil were visible from overflights, and reported by fishermen and observers in vessels in the waters off the coast.

Oil began to come ashore on the coasts of Spain and Morocco within a few days of the spill. The Moroccan province of Al Hoceim was the hardest hit area. The first impacts here were on August 13. Large slicks were observed in the bay and in nearby offshore areas of Al Hoceim. Most of the oiling along the Moroccan coastline consisted of a band of tarballs between two- and six

feet wide. With the exception of a few sites, this band was nearly continuous for the approximately 600 kilometers of Moroccan coastline.

Countermeasures and Mitigation:

Slicks were monitored and tracked as they neared the coastlines of Spain and Morocco. Heavy fuel oil is resistant to chemical dispersants. Spanish authorities attempted with little success to break up the slick with *dispersants* sprayed from a tug. A representative from the International Tanker Owners Pollution Federation, Ltd. (ITOPF) recommended that chemical dispersant use be discontinued, as it could have made mechanical cleanup techniques ineffective. No other open-water cleanup and recovery operations were undertaken. Another tug remained offshore monitoring the slick with boom, a skimmer, and dispersants aboard, but these dispersants were never used.

The oil was mechanically dispersed at sea and in coastal waters. This involved running a boat through the oil at high speed, churning and breaking up the oil into smaller particles. Because of this technique, most of the beach impacts were in the form of tarballs and lumps of oil.

Precautionary booming was used at tourist beaches in Al Hoceim. Other sites were protected using floating booms, sorbent pillows, and fixed absorbent barriers made of straw bales. Booms were constructed from straw bales and staked into the shallow water to protect a shellfish lagoon. The inflatable barriers were reportedly not effective because the personnel on-scene did not have adequate training or experience to install or tend them properly.

The passage into the lagoon at Nador was protected with a fixed barrier after floating inflatable boom was shown to be ineffective. The lagoon contained a sensitive sea bream, shrimp, and oyster farming installation. There was considerable concern about long term effects to the sea bream population as they are usually collected from outside the lagoon. There were no reports of contaminated fish catches.

Cleanup of the coastline was accomplished manually using shovels, scrapers, and rakes. In some locations, straw was placed on the shoreline to absorb the oil as it came ashore. The straw was then burned. Some mechanical equipment was used to remove the oily waste and debris from the beach. At a Cabo Negro site, the beach was raked daily with an automatic raking machine pulled behind a tractor. Beach cleaning was performed daily on the private resort beaches by the hotels and resorts that owned them. One case of *dispersant use on the beach* in Al Hoceim province was reported. This occurred on a private beach in Bades Cove.

The affected beaches along the Spanish coast were tourist and recreational beaches. These beaches were cleaned thoroughly and professionally on a regular basis. Cleanup of the pollution along these areas proceeded rapidly. Most of the beach impacts in this area were in the form of scattered tarballs.

Recovered waste was often buried at the back of the beach from which it came. Waste from other sites was taken to a garbage dump and disposed with domestic waste.

Other Special Interest Issues:

A French Customs aircraft equipped with remote sensing gear arrived in Malaga on August 10, 1990. The aircraft was equipped with *side-looking airborne radar (SLAR)*.

Moroccan authorities *suspended fishing*. There was a severe impact to the tuna fishing industry in Morocco. There was no reported significant tuna mortality, but the catch rigs were badly oiled and the tuna stopped eating mackerel for a time. Fishermen reported 70 to 80 percent reduction in their catches. Some of the oiled fishing equipment was thrown away, but most of the tuna rigs were cleaned in place. Spanish authorities reportedly suspended fishing for the first few days of the spill.

The spill occurred during the height of the tourist season along both the Spanish and Moroccan coastlines. There was a mixed effect to tourism in the area. Among many private clubs, there was no noticeable reduction in business. Authorities in Morocco reported many cancellations and a severe reduction in the number of tourists present. Tourists who were staying in campsites along the beaches vacated them. There was a minimal effect reported in Spain. This was attributed to the amount of oil that impacted the Spanish coast, the accessibility of the beaches, and the regular, general cleaning of the beaches.

References:

- Genwest Systems, Inc. communications with ITOPF representatives.
- Oil Spill Intelligence Report, 2/21/91.

Name of Spill: *Sea Star*
Date of Spill (mmddyy): 12/19/72
Location of Spill: Gulf of Oman
Latitude: 25 18 N
Longitude: 057 34 E
Oil Product: Crude Oil
Oil Type:
Barrels: 937,000
Source of Spill: Tank Vessel
Resources at Risk:
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest:
Shoreline Types Impacted:
Keywords: International Tanker Owners Pollution Federation (ITOPF), collision, fire, sinking.

Incident Summary:

Early on the morning of December 19, 1972, the *Sea Star* and the *Horta Barbosa* collided in the Gulf of Oman. Both vessels caught fire, and were abandoned by their crews. The *Horta Barbosa* fire was extinguished within a day. The *Sea Star* drifted SSE, leaking burning oil from a forty-foot hole in its side. The *Sea Star* was taken under tow by Awal Contracting and Trading Company tug while still on fire on December 21. Occasional explosions rocked the vessel, and eventually caused it to sink at 25 04 N, 058 12 E on December 24, 1972.

Behavior of Oil:

Approximately 937,000 barrels of crude oil spilled from the *Sea Star*.

References:

- Genwest Systems, Inc. communications with ITOPF representatives.
- Hooke, N. Modern Shipping Disasters 1963-1987. Lloyds of London Press. 1987.

Name of Spill: Seal Beach Well Blowout

Date of Spill (mmddyy): 10/31/90

Location of Spill: Seal Beach, California

Latitude: 33 46 N

Longitude: 118 11 W

Oil Product: Crude oil

Oil Type: Type 3

Barrels: 20

Source of Spill: Platform

Resources at Risk: Wildlife Refuge, tidal wetlands, coastal diving birds, waterfowl.

Dispersants: No

Bioremediation: Yes

In-situ Burning: No

Other Special Interest: Habitat impact due to oil, research conducted.

Shoreline Types Impacted: Tidal wetlands.

Keywords: National Wildlife Refuge, United States Fish and Wildlife Service (FWS), blowout.

Incident Summary:

On October 30, 1990, a drilling rig within the Seal Beach National Wildlife Refuge (NWR) blew out. The blowout resulted when the drill hit a high pressure gas pocket and a bolt on the safety collar gave out. Natural gas and a mist of approximately 20 barrels of crude oil were propelled into the air. The oil mist was carried into the adjacent tidal wetlands by the wind. Breit Burn Energy Corporation, the owners of the drilling rig, assumed responsibility, and hired L & J Vaughtco International to clean up the spill. The United States Fish and Wildlife Service (FWS) supervised the cleanup and bioremediation operations.

Behavior of Oil:

Twenty barrels of crude oil were spread in a mist over 3 acres of wetlands.

Countermeasures and Mitigation:

The FWS was notified the day of the blow out, but it was not verified that the oil had impacted the wetlands. On October 31, the assistant manager of the Seal Beach NWR informed the FWS that three acres of the refuge had been oiled. Inspections by FWS, NWR, and cleanup personnel revealed oiled salt marsh grasses, primarily cordgrass and pickleweed. The FWS supervised sampling of water, sediments, and vegetation to determine the extent of the oiling.

Other Special Interest Issues:

Bioremediation operations began one week after the oiling of the wetlands. The initial application consisted of 20 ounces of the fertilizer *Miracle-Gro* and 8 pounds of the bioaugmentation product *INOC 8162* mixed with water. A week later a second application consisted of *Miracle-Gro* mixed with water. The treatment involved application of the products to oiled grass blades with hand spraying equipment. *Subsequent studies, involving bacterial counts and carbon 14 mineralization, showed that bioremediation did not significantly increase the degradation of the oil.* Additional studies concerning the ability of *INOC 8162* were conducted by the U.S. Environmental Protection Agency. Uninoculated controls of Prudhoe Bay crude oil showed little or no difference in the concentrations of indicator compounds after 16 days. *The microbial product INOC 8162 was ineffective in accelerating biodegradation of oil under controlled conditions.*

References:

- Hoff, R. 1991. A Summary of Bioremediation Applications Observed at Marine Oil Spills. Report HMRB 91-2. NOAA.
- USFWS Seal Beach NWR Bioremediation Studies Summary
- USFWS Seal Beach NWR Oil Spill Briefing

Name of Spill: *SFI 41*
Date of Spill (mmddyy): 11/24/85
Location of Spill: River mile 43.7, Mississippi River, Missouri
Latitude: 37 20 N
Longitude: 089 30 W
Oil Product: No. 6 Fuel Oil
Oil Type: Type 4
Barrels: 16,300
Source of Spill: Tank Barge
Resources at Risk:
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest:
Shoreline Types Impacted: Vegetated riverbanks.
Keywords: Gulf Strike Team (GST), containment boom.

Incident Summary:

On the morning of November 24, 1985, the *M/V Jimmie L* and its tow, the *SFI 41*, struck the Thebes Railroad Bridge at mile 43.7 on the Mississippi River. The barges broke free, and began to drift. The barge *SFI 41* struck a bridge span pier, rupturing two of the starboard cargo tanks, spilling 16,300 barrels of number 6 fuel oil into the river. The *SFI 41* was later retrieved by the *M/V Charles Southern* and pushed into the riverbank at mile 30.8. The Captain of the Port (COTP) Paducah, Kentucky, was the On-Scene Coordinator (OSC) for the incident.

Behavior of Oil:

No. 6 fuel oil is a heavy product with an API gravity that ranges from 7 to 14. The oil impacted the riverbank in isolated areas between river mile 0.0 and river mile 39.5. Most of the oil dissipated rapidly due to the high energy turbulence of the Mississippi River.

Countermeasures and Mitigation:

On an early November 24 overflight, the OSC noted heavy pollution between river miles 13.0 and 39.5. In the early afternoon, MSO Paducah response personnel reported failed attempts to boom the *SFI 41* due to high-velocity river currents. The OSC activated the Gulf Strike Team (GST) that afternoon, and contracted Riedel Environmental Services, Inc. (RES) to conduct cleanup operations.

On November 25, personnel from the GST arrived and made arrangements with MSO Paducah to establish a command post and begin surveying. The OSC made an overflight in the morning and observed extensive pollution between mile 0.0 and mile 39.5. System Fuels Inc., the owner of *SFI 41*, informed the OSC that they would assume responsibility for the spill. They

retained RES for cleanup operations. By the late afternoon, the GST equipment and the remaining GST personnel arrived.

At noon on November 26, the lightering barge *APEX 3504* arrived and began offloading the oil remaining on the *SFI 41*. Offloading was completed late that night. RES began cleanup operations.

On November 27, the OSC determined that only isolated areas required cleaning, and released the GST. Cleanup operations continued until suspended on December 12, due to bad weather. Cleanup was resumed from January 8 until January 15 at which time the OSC released the owner from any further responsibility.

References:

- USCG On-Scene Coordinator's Report

Name of Spill: Shell Oil Complex
Date of Spill (mmddyy): 04/23/88
Location of Spill: Carquinez Straits, Martinez, California
Latitude: 38 00 N
Longitude: 122 07 W
Oil Product: San Joaquin Valley heavy crude oil
Oil Type: Type 4
Barrels: 8,700
Source of Spill: Facility
Resources at Risk: Freshwater marshes, salt marsh, migratory routes, waterfowl, tidal mudflats, rodents.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Habitat impact due to oil, wildlife impacts, wildlife rehabilitation, research conducted.
Shoreline Types Impacted: Exposed seawalls, piers, exposed rocky shores, riprap, freshwater marshes, fringing salt marshes, extensive salt marshes
Keywords: Clean Bay Inc., vacuum truck, weir/pump skimmer, sorbent pompoms, vegetation cutting, high-pressure warm-water washing, sorbent boom, filter fences, siphon dams, U.S. Navy Superintendent of Salvage (NAVSUPSALV), International Bird Rescue Research Center (IBRRC), California Department of Fish and Game (CA DFG), Marco skimmer.

Incident Summary:

On April 23, 1988, the Shell Oil Complex at Martinez, California released *approximately 8,700 barrels of San Joaquin Valley crude oil* into Peyton Slough and Shell Marsh. Some oil travelled through Peyton Slough into Suisun Bay and Carquinez Strait. Oil was first sighted in the water near the Shell dock in Carquinez Strait. The United States Coast Guard (USCG) was notified and the source of the leakage was secured. Shell Oil Company accepted responsibility for the spill and contracted Clean Bay, Inc. to initiate cleanup operations.

Cleanup operations began on April 23 on the marshes, shorelines, and waters of the Martinez area, including Peyton Slough, Pancheco Creek, Shell Marsh, Suisun Bay, and Carquinez Strait. The cleanup involved personnel from the USCG, National Oceanic and Atmospheric Administration (NOAA), Environmental Protection Agency (EPA), U.S. Navy (USN), and the California Department of Fish and Game (CA DFG). Members of various city, county, and state governments were also involved. Cleanup was completed on August 8.

Behavior of Oil:

San Joaquin Valley crude oil is a heavy product with an API gravity value between 10.3 and 13.2. The tide gate between Peyton Slough and Suisun Bay forced some oil to overflow the slough during high tide and drain into adjacent Shell Marsh. Approximately two-thirds of this 170-acre marsh were contaminated with oil.

Oil flowed from Peyton Slough into Suisun Bay and Carquinez Strait. Shoreline was impacted for approximately 11 miles, from the Carquinez Bridge to the west in Carquinez Strait, to Roe and Ryer islands to the east in Suisun Bay. Heavy sheen was reported even further to the west. Oil was forced into smaller sloughs by tides, resulting in a total of approximately 50 miles of contaminated shoreline in Peyton Marsh.

Several sensitive areas were affected by this spill. On the south side of Carquinez Strait, the marsh and riprap of Martinez Shoreline Park, the Martinez Marina (a staging area for the cleanup operation), three miles of rocky shoreline (including some industrial development), and the salt marshes in the area of Peyton Slough and Pancheco Creek were impacted with oil. On the north side of the Carquinez Strait, oil impacted the shoreline of Benicia (residential areas) and the rocky shoreline to the west near the Carquinez Bridge. The west side of the islands at the east end of Suisun Bay showed some oiling of shoreline vegetation, but generally were not heavily oiled.

Countermeasures and Mitigation:

Open-water recovery was conducted using skimmers (owned and operated by *Clean Bay, Inc.* and the U.S. Navy). On one of the larger sloughs, *low pressure water* was used to move the oil on the water to a *Marco Class I skimmer*.

Oil recovery in the fresh water marsh was accomplished with *vacuum trucks, air activated pumps, a weirl/pump skimmer, and pompom sorbents*. Following the removal of as much oil as possible, the marsh was drained. Powered hand-held *weed cutters* were then used to remove any residual oiled vegetation. Effort was made to avoid root and rhizome damage during this process. Cleanup personnel removed puddles of free-floating oil and were instructed to avoid walking on the oiled substrate in the marsh. Oil remaining on the substrate after the vegetation cutting was removed with shovels or cultivated to speed biodegradation.

In salt marsh sloughs, oil contamination was generally limited to a band at the high tide line, and on the stems of marsh vegetation. Due to the potential hazard to wildlife in the marshes, *contaminated vegetation was cut* using the same technique as in the freshwater marshes. Oiled vegetation was cut and removed as necessary from the bay fronts of most of the salt marshes.

High-pressure, warm-water washing was used to remove oil from the rocky intertidal shoreline at Dillon Point, and from the bulkheads and piling in the Benicia, Glen Cove, and Martinez marinas. *Sorbent boom* was used to keep the oil at the shoreline during these operations.

Sorbent pompoms were used on Ryer Island, the Benicia shoreline, and Martinez Waterfront Park. The riprap at Martinez Waterfront Park was removed and replaced to facilitate removal of oil trapped in spaces of the breakwater.

Filter fences with sorbent pompoms were constructed across sloughs which were too narrow to permit skimmers. The sorbent pompoms were removed and replaced at low tide every day for three weeks during the cleanup.

Two *siphon dams*, made of rock, mud, sand, and hay bales, were placed across Peyton Slough in the first four days of the spill. They were used in conjunction with boom farther downstream to stop the flow of oil from the slough into the Carquinez Strait. The effectiveness of the boom was reduced due to high currents and grounding of the boom at low tide. The dams proved effective in containing oil and provided good collection points for vacuum trucks.

Other Special Interest Issues:

Two *endangered species* inhabited this area: the *salt marsh harvest mouse* and the *California Clapper Rail*. Also at risk from this spill were *wetlands* of the Suisun Marsh, which is the largest remaining wetland region on the *Pacific flyway*. This habitat provides a feeding and resting area for millions of birds during annual migrations. The spill occurred after the major spring migration of waterfowl, so effects to wildlife were far less than were possible.

Wildlife collection centers were set up in Martinez and Benicia. Animals were then transported to the rehabilitation centers at the *International Bird Rescue Research Center* in Berkeley and the *Alexander Lindsay, Jr. Museum* in Walnut Creek. Wildlife rehabilitation was performed by trained volunteers and managed by biologists from the Department of Fish and Game.

A natural resource damage assessment study concluded that the effect of the oil was generally limited to the fish, macroinvertebrate, and benthic communities in the sloughs. The oiled vegetation, which did not extend beyond the high tide line, was mostly recovering by Fall 1989. Bird populations returned to pre-spill levels after the marsh was reflooded. Removal of salt marsh harvest mouse habitat as part of the response may preclude maintenance of a viable population in Shell Marsh.

Of 589 *oiled birds recovered*, 171 were dead. Approximately two-thirds of the 418 birds taken to the treatment centers survived. Forty eight mammals, mostly muskrats, died as a result of the spill. Seven live muskrats were taken to the centers for cleaning, but only four survived. Four *endangered salt*

marsh harvest mice, not contaminated by oil, were killed in CA DFG traps. The CA DFG used *propane cannons* and a *starshell-type device* to scare birds away from the contaminated areas in oiled marshes.

The first federal representatives on the scene were officials from the USCG Marine Safety Office (MSO) San Francisco Bay, which assumed the responsibilities of On-Scene-Coordinator (OSC) for the incident. It was later discovered that the incident occurred in an area under the jurisdiction of the U.S. Environmental Protection Agency, while the area impacted fell under USCG jurisdiction. By agreement between these two agencies, the USCG remained the OSC.

On April 25, the spill was *partially federalized* to obtain two U.S. Navy *Marco Class V skimmers* (with crews and support personnel) from the *U.S. Navy Supervisor of Salvage (NAVSUPSALV)*.

The San Francisco Vessel Traffic Service issued an advisory for large commercial vessels to reduce speed in the Carquinez Strait. This was done at the request of the OSC to prevent wake interference with skimming operations.

A team of three people (representatives from USCG, CA DFG, and Shell) suggested guidelines for determining proper cleanup techniques used during the spill. The team kept the OSC informed as cleanup operations were performed. Use of these guidelines was felt to be a very effective and organized method of controlling cleanup operations falling under several jurisdictions. The OSC estimated that 90% of the spilled oil was recovered within the first four weeks of the cleanup.

References:

- Fischel, M. 1991. Natural Resource Damage Assessment of the Shell Oil Spill at Martinez, California, Oil Spill Conference Proceedings, 1991, pp.371-376.
- Fraser, et al. 1989. Response to the April 1988 Oil Spill at Martinez, California, Oil Spill Conference Proceedings, 1989, pp. 65-69.
- NOAA Response Report
- OSC Report

Name of Spill: Shell Platform 26
Date of Spill (mmddyy): 12/01/70
Location of Spill: Gulf of Mexico, Louisiana
Latitude: 28 46 N
Longitude: 090 10 W
Oil Product: Crude oil
Oil Type: Type 3
Barrels: 58,640
Source of Spill: Platform
Resources at Risk: Beaches
Dispersants: Yes
Bioremediation: No
In-situ Burning: No
Other Special Interest: Human health and safety concerns, complex salvage operations.
Shoreline Types Impacted: Sand/gravel beaches, exposed rocky shores.
Keywords: Corexit 7664, Shell Oil Herder, skimmer, straw, boom, vacuum truck, explosion, fire.

Incident Summary:

On December 1, 1970, Shell Oil Co. Platform 26 exploded and caught fire. The platform included 22 production wells with a capacity of 15,000 barrels of crude oil per day. The flames from the burning platform blazed 400 feet into the air. The 21-B well, with a 424-barrel per day capacity, ruptured 12 feet above the water. By December 3, the service crane had collapsed towards the center of the platform at a 60° angle. Burning oil covered the surface of the water within 50 feet of the platform. By December 7, well No. 21-B was contributing to 30-50 percent of the fire. Shifting winds, fog and rough seas slowed response efforts at times.

Holes were shot into the tubing of some of the wells to determine whether oil was still being produced. On January 12, Shell Oil Co. personnel perforated a relief well in an attempt to contain the flow. On January 20, eight of the wells remained on fire. *Corexit 7664 dispersant was applied to the slick at a rate of 3 barrels per hour.*

Response operations began moderating on March 1. A U.S. Coast Guard cutter and helicopter were released from the scene. Shell Oil Co. officials were required to submit daily pollution reports to the U.S. Coast Guard Captain of the Port (COTP), New Orleans, in advance of any operations that may have increased pollution.

Drilling, capping, and pumping of the wells continued throughout April. By April 16, the estimated rate of release was 20 barrels per day. The slick was reportedly staying within a 6-mile radius of the platform, with sheen extending to 12 miles. The slick was reduced to sheen during the following months as pumping and capping operations continued.

Beach surveys were conducted by personnel from the U.S. Coast Guard, Shell Oil Co., the U.S. Environmental Protection Agency (EPA), Louisiana Wildlife and Fisheries, and other local observers. *The only shoreline oiling that resulted from the incident was between Caminada Pass and Bay Champagne.* The case was closed by the U.S. Coast Guard on May 17, 1971. The explosion and subsequent fire killed four people and seriously burned 37 others.

Behavior of Oil:

A slick of burning oil spread 50 feet from the platform on the day of the incident. On December 21, a slick entering Timbalier Bay caused *minimal beach impact*. December 28 pollution surveys reported four scattered oil accumulations. One accumulation was observed at the southern end of Grand Isle and three were southwest of Caminada Pass. Sheen on the water surrounding the platform continued to dissipate.

On January 13, oil along Grand Isle Beach was reported to be breaking up into globs and patches with the incoming tide. A 1.5-inch thick accumulation of oil was observed near the Grand Isle Beach jetty. A slick 10 feet wide and 6-12 inches thick floated on the water.

By January 20, the slick extended two miles southwest of the fire, producing a fan of rainbow sheen for another six miles. Streaks of sheen extended for up to 29 miles southwest of the platform with a maximum width of four miles. Throughout February, March, and April, the slick became progressively smaller as it was driven by the currents and winds. By April, extensions of rainbow sheen were all that remained of the slick.

Countermeasures and Mitigation:

Several *drilling rigs* were constructed in an effort to contain the spilling oil. Salt water was pumped into the 21-B relief well starting December 30. *Jet Barges Jaraffe* and *Red Adair* pumped approximately 19 million gallons of water per day to cool the structure. The first of the relief wells, started on December 5, reduced the oil flow.

Chemical dispersant spraying was started early in the response. *Corexit 7664* was sprayed in the immediate platform and work areas to prevent oil slicks from developing. Slicks forming near the platform may have ignited, endangering response personnel. The dispersant concentration was not allowed to exceed 0.03 percent of the total spray stream, due to its toxic nature. The Regional Response Team concurred with the conditional use of dispersants.

Shell Oil Herder was used to aid skimming operations two miles southwest of Belle Pass. Aerial application of the substance was also used along the shoreline from the west end of east Timbalier Island to 1.5 miles west of Belle Pass. Skimmers, straw, and boom were used to contain and collect oil when possible. *Vacuum trucks* recovered oil from Grand Isle Beach. Six truck loads of litter and 600 gallons of emulsion were picked up by January 15.

Other Special Interest Issues:

Well head piping was severely damaged by the intense heat of the fire. Shell Oil Co. personnel constructed an *abrasive cutting boom* to attempt to cut the damaged well head off of the B-8 well, which was bent into the water and partially submerged, causing a pollution problem. This device was used to cut the well heads off of B-3 and B-5. A *sand blast cutting device* was used to cut the piping of wells B-8 and B-28. Well heads B-17, B-15, and B-4 were cut by February 11.

References:

- IFP. Platform Databank on Accidents to Drilling Vessels or Offshore Platforms (1955-1989). #7032.
- U.S. Coast Guard POLREP file

Name of Spill: *Sivand*
Date of Spill (mmddyy): 09/28/83
Location of Spill: Humber Estuary, England
Latitude: 53 40 N
Longitude: 000 15 W
Oil Product: Nigerian Forcados Crude Oil
Oil Type: Type 2
Barrels: 48,000
Source of Spill: Tank Vessel
Resources at Risk: Tidal mudflats, salt marshes, waterfowl, wading birds, nature reserves, wildlife refuges, recreational beaches, industrial water intakes, commercial fisheries, marinas, diving coastal birds.
Dispersants: Yes
Bioremediation: No
In-situ Burning: No
Other Special Interest: Wildlife impacts.
Shoreline Types Impacted: Tidal mudflats, salt marshes.
Keywords: International Tanker Owners Pollution Federation (ITOPF), manual removal, boom, skimmer, vacuum truck, collision.

Incident Summary:

Very early on the morning of September 28, 1983, the tanker *Sivand* grounded on a jetty at the Immingham oil terminal in the Humber Estuary. Cargo tanks ruptured upon impact, and Nigerian Forcados Crude Oil spilled into the Humber River estuary.

Behavior of Oil:

Nigerian Forcados crude oil has an API gravity of 29.7, and a pour point of -4 degrees F. Approximately 48,000 barrels of the crude oil spilled into the estuary. Oil impacted the north and south shores of the estuary late on September 28, including the docks at Immingham and Grimsby, and beaches at Cleethorpes. Easterly winds on September 30 pushed the oil up the Humber River as far as the River Trent. The mudflats of the Blacktoft Sands Nature Reserve, and the salt marshes of the River Ouse were oiled on September 30.

Of the oil spilled, it was estimated that 12,000 barrels evaporated, 16,000 barrels were chemically dispersed, and the rest dispersed naturally, was carried out to sea, or came ashore. The oil spread on the tides throughout approximately 50 miles of the estuary. About 900 metric tons of oil and oiled debris were recovered in cleanup operations.

Countermeasures and Mitigation:

British Petroleum's Environmental Control Center was notified of the spill, and sent a team including representatives from the British Petroleum Oil Spill Response Base at Southampton. The team came on scene on the afternoon of September 28. Her Majesty's Coast Guard notified the Marine

Pollution Control Unit (MPCU) of the Department of Transportation, which immediately contracted six tugs and four aircraft to spray dispersants.

The oil was recovered from the various parts of the estuary using disc and vacuum skimmers. The beach at Cleethorpes was cleaned with front end loaders and shovels. Oil was recovered from between the docks at Immingham and Grimsby with collection booms and *Komara skimmers*. Recovered oil was suctioned by vacuum trucks and transported to a refinery for disposal. At one point the downdraft from a helicopter was used to herd the oil into containment booms. Debris in the water among the docks hindered skimming operations.

Dispersant operations began on the morning of September 28 under the direction of the MPCU. Poor weather prevented the use of aircraft on the first morning's operations, but the six tugs began spraying dispersants on the slick near the *Sivand*. Later that day, weather conditions improved and two of the aircraft joined the operations. Operations continued throughout the next day. By September 30, the large patches of oil were broken up, and dispersant spraying operations were terminated. Approximately 680 barrels of dispersant were applied during the spill response.

Oil was recovered from the various tributaries of the Humber River using containment booms, Komara skimmers and vacuum trucks. On October 2, a helicopter deployed booms across the creek into the Blacktoft Sands Nature Reserve to prevent oil on its outlying mudflats from penetrating farther into the reserve. By October 7, the boom was too waterlogged to function properly, but the threat of future oiling was gone. Cleanup operations ended on October 11, 1983.

Other Special Interest Issues:

Among the birds threatened by the oil were Mallard Ducks, United Kingdom Bearded Tit, and Water Rails. Oiled waterfowl and wading birds were observed on the Ouse and Trent rivers, and in the Blacktoft Sands Nature Reserve. The Royal Society for the Protection of Birds reported 160 dead, oiled birds found, and estimated that up to 4,000 birds were oiled. There were extensive mortalities among ragworms in the Humber Wildlife Refuge.

There was some oiling of nets belonging to fishermen operating out of Grimsby.

References:

- Genwest Systems, Inc. communications with ITOPF representatives.
- Gundlach, E. and Marshall, M. 1990. The Physical Persistence of Spilled Oil: An Analysis of Oil Spills Previous to Exxon Valdez. Final Report. HAZMAT. OAD. NOAA. pp.47-68.
- Hooke, N. Modern Shipping Disasters 1963-1987. Lloyds of London Press. 1987.
- Mitchell, et al. 1985. An estuarine oil spill incident in the United Kingdom, Oil Spill Conference Proceedings, 1985, pp. 342-345.
- Nichols, J.A. and Parker, H. 1985. Dispersants: Comparison of Laboratory Tests & Field Trials with Practical Experience at Spills, Oil Spill Conference Proceedings, 1985, pp. 421-427.

Name of Spill: *St. Peter*
Date of Spill (mmddyy): 02/05/76
Location of Spill: Cabo Manglares, Colombia
Latitude: 01 30 N
Longitude: 079 30 W
Oil Product: Orito Crude Oil
Oil Type: Type 2
Barrels: 279,000
Source of Spill: Tank Vessel
Resources at Risk: Mangroves, birds, fish, molluscs, crustaceans, reptiles.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Habitat impact due to oil, logistical or operational problems, research conducted, wildlife impacts.
Shoreline Types Impacted: Mangroves, sand/gravel beaches, exposed rocky shores.
Keywords: Fire, explosion, sinking.

Incident Summary:

The tank vessel *St. Peter* departed Tumaco, Colombia on February 4, 1976 with 279,000 barrels of Orito crude. On the evening of February 4, a fire broke out in the engine room and the crew abandoned ship after unsuccessful attempts to extinguish the fire. There were subsequent explosions on board the *St. Peter* and the fire continued to burn until February 5 or February 6, when the vessel sank in over 3,000 feet of water approximately 18 miles off Cabo Manglares, Colombia. An Ecuadorian patrol boat returning to the site on February 6, found only an oil slick approximately one square mile in area.

The sunken vessel released an initial burst of oil and then continued to slowly leak oil for some time. The vessel was known to be leaking oil nine months after the sinking.

The area affected by the spill covered a distance of over 200 miles, from Buenaventura, Colombia in the north to Punta Galera, Ecuador in the south. The predominant shorelines in the area were sandy beaches, rocky shores, and estuarine areas with mangroves. The heaviest oiling occurred in the area of Tumaco, Colombia and portions of the shoreline to the south, near the border of Ecuador.

Behavior of Oil:

Orito crude is a light Columbian crude with an API of 35.5, viscosity of 4.8 centistokes, and a pour point of 25 degrees F. Oil released from the vessel moved in a northeasterly direction and came ashore in Tumaco in Colombia, and Esmeraldas and Isla Gallo in Ecuador.

Countermeasures and Mitigation:

Several logistical and financial constraints restricted the cleanup and response options available to Colombia and Ecuador. Little or no oil spill control and cleanup equipment was available in the area, and freight costs to bring such equipment into the area were high. Some dispersant was available in Ecuador, but it was considered toxic, and no equipment was available to apply the dispersant to the spill. Specialized diving equipment needed for any vessel salvage was unavailable.

An advisor from the Canadian Coast Guard was consulted for treatment and contamination removal recommendations, but no known response activities were ever undertaken.

Other Special Interest Issues:

Mangrove swamps in Tumaco and to the south were severely oiled in late February 1976. As a result, mangroves suffered defoliation and some trees died. In some of the locations where trees died, there was evidence of erosion. Sessile organisms (barnacles, mussels, and oysters) in areas of heavy oiling were absent or greatly reduced in numbers for at least two months after the spill. Some organisms, like gastropods, moved out of the oiled area. Numbers of fiddler crabs, especially young crabs, were reduced, and dead fish, snakes and sea birds were observed.

Mangroves also served as breeding grounds for two commercially important species harvested in the area. Shrimp, which were valued by the commercial fisheries at approximately \$18 million per year, and a type of clam considered a delicacy in Ecuador and Colombia, were thought to be susceptible to long-term effects from the oil.

Between May and June 1976, observers noted that most of the oiling on the Tumaco area mangroves was located at the highest high tide line and that lower areas had generally been cleaned by tidal action. In many areas, mangroves that had been defoliated had recovered and areas that were previously devoid of crabs, molluscs, barnacles, fishes, shrimp, and insects had been repopulated by these species.

Another possible consequence of the spill was the disappearance of migratory tuna usually present in the Tumaco area between March and April. It was speculated that the tuna may have avoided the area due to the oiling. Unusually high tuna catches in other parts of the region supported this theory.

References:

- Modern Shipping Disasters 1963 - 1987, Hooke, Norman, Lloyd's of London Press, p. 405.
- Sinking of Tanker St. Peter off Colombia; Hayes, T. M., Proceedings Oil Spill Conference, 1977, pp. 289-291.
- The Effects of Oil Pollution on Mangroves and Fisheries in Ecuador - Colombia, Swedish Water and Air Pollution Research Institute; Jernelov, A., Linden, O., May 1981.

Name of Spill: *STC-101*
Date of Spill (mmddyy): 02/02/76
Location of Spill: Chesapeake Bay, Northampton County, Virginia
Latitude: 37 49 N
Longitude: 076 11 W
Oil Product: No. 6 Fuel Oil
Oil Type: Type 4
Barrels: 5,959
Source of Spill: Tank Vessel
Resources at Risk: Diving coastal birds, waterfowl, shorebirds, wading birds, gulls, oysters, mussels.
Dispersants: No
Bioremediation: No
In-situ Burning: Yes
Other Special Interest: Habitat impact due to oil, wildlife impacts, volunteer response and organization, unusual or experimental cleanup techniques.
Shoreline Types Impacted: Salt marshes, riprap, piers, sand/gravel beaches.
Keywords: Vacuum truck, manual removal, high pressure washing, vegetation cutting, sub-surface oil, salvage, boom, disposal.

Incident Summary:

On February 2, 1976, the petroleum transport barge *STC-101*, under tow by the Allied Towing Company Tug *Falcon*, partially sank during stormy weather in Chesapeake Bay approximately 3.5 miles off Smith Point Light. The bow, protruding at a 30° angle, was approximately 30 to 40 feet out of the water while the stern rested on the bottom in approximately 105 feet of water. The *STC-101*, loaded with 19,531 barrels of No. 6 fuel oil, was en route from the AMOCO Refinery in Yorktown, Virginia, to the AMOCO Terminal in Baltimore at the time of the incident.

Initially, only a small rainbow sheen, believed to be from deck machinery diesel and lube oil, was observed around the barge. Clean Water Inc. was contracted by Steuart Transportation, the barge owner, to stage pollution abatement equipment near the scene in the event of a spill during salvage operations. An underwater survey of the barge on February 4 reported no oil leaking from the barge, however, oil patches and light sheen were reported in the surrounding area on February 5. After the *STC-101* was refloated on February 6 by the McLean Construction Company, the barge was intentionally grounded in Ingram Bay for dewatering operations. Extensive damage to the port side was discovered. Severe wind and weather conditions as well as poorly maintained and improperly secured cargo hatches may have contributed to the oil spillage.

After the U.S. Coast Guard Marine Safety Office Hampton Roads received several reports of oil and birds washing up on surrounding shorelines, a Federal spill was declared on February 8. On February 19, the AMOCO Terminal in Baltimore, Maryland, concluded that 5,959 barrels of oil were missing from the *STC-101* barge.

Beach and marsh areas of both the eastern and western shores of Chesapeake Bay were contaminated. Large areas of dormant oiled marsh grasses were cut, leaving the root systems intact. Virginia authorities estimated that between 20,000 and 50,000 waterfowl were killed as a result of the spill.

The bulk of the cleanup was completed by mid-March. A final inspection on November 5 revealed little evidence of oil remaining in the affected areas.

Behavior of Oil:

No. 6 fuel oil is a heavy product with an API gravity that ranges from 7 to 14. A light horseshoe-shaped sheen observed around the vessel the day of the incident was believed to be diesel and lube oil from the deck machinery. An aerial survey on February 5 revealed several areas of scattered light sheen in the water between Bluff Point and Smith Point Light. Also, a sheen measuring 1 mile wide by 3 miles long with widely scattered patches of black oil was observed approximately 8-10 miles due south of the barge. On February 7, approximately 800 gallons of oil washed ashore east of the Windmill Point Marina. A large slick impacted the eastern side of the bay between Nadua Creek and Cherrystone Creek on February 8. *This 71-mile distance consisted of creeks, marshes, and irregular shoreline, of which 27 miles suffered some oiling*. The most adversely affected area was a 15-mile stretch between Hungar's Creek and Nassawadox Creek. Observers on a February 9 overflight reported heavy concentrations at Fleet Island on the western shore. Oil also pooled in localized areas such as Windmill Point, Cameron Marsh, and Gwynn's Island on the western shore.

Since no heavy oil impacts were observed until February 7, the heavy No. 6 oil was believed to be submerged just below the surface of the water until it reached the shore. Adverse weather conditions made the oil difficult to observe from the air. Approximately 3,980 of the 5,959 barrels of oil spilled were recovered during cleanup operations. Much of the missing oil was believed to be on marsh grass roots on the eastern shore.

Countermeasures and Mitigation:

Heavy pools of oil on the sand beaches were removed using *front-end loaders*. This cleanup method was used only at low tide and in daylight hours. The effort was complicated by tidal exchanges covering the oiled areas with new layers of sand that created oil and sand mixtures.

Boom was deployed around the vessel during salvage and towing operations. Containment boom was also used around the Windmill Point Marina. Booms were ineffective because of strong wind, wave, and tidal action. *Vacuum trucks* also proved ineffective because the oil was viscous and plugged the suction hoses. Consequently, *shovels* were the predominant beach cleanup tool.

High-pressure washing was effectively used to remove oil on rocky areas, piers, and groins. High-pressure washing was also tested on marsh grass, but quickly proved ineffective due to the viscosity of the oil.

Salt marshes on the eastern side of the bay were severely impacted. After all responsible parties agreed that it was not advisable to remove the marsh grass root system, the On-Scene Coordinator (OSC) decided to *cut and remove the marsh grass* while leaving the root system intact. Grass cutting was done by hand or with "*weedeaters*." Dry grass was spread over areas where thick oil remained in the root system, walked on to compact it into the soil, and removed using rakes and pitchforks. This slow, labor intensive process was used on ten miles of shoreline. The contaminated grass was transported to a landfill for disposal.

Disposing of 4,000 barrels of recovered oil in landfills was not a viable option on the eastern side of the bay since the water table is close to the surface and groundwater is the primary source of drinking water in this area. The State Water Control Board, State Department of Health, and State Air Pollution Control Board decided the landfills could be used as burning sites. *A brush-and tree stump-burning device consisting of a gasoline-powered forced draft blower hooked to a tractor was used to burn recovered oil.* The burned residue was disposed of in the landfill. Sand/oil mixtures recovered during beach cleanup on the eastern shore were used as *road fill* and *repair material* for damage done by heavy cleanup machinery. The sand/oil mixture collected on the western shore was given to the Lancaster County Raceway for dust control use.

Other Special Interest Issues:

The Chesapeake Bay Oil Spill Task Force was organized as an investigative group after the oil spill. The purpose of the Task Force was to assess cleanup activities and environmental damage, consider preventive measures, and provide input to the Attorney General's office to support potential litigation. Preliminary reports indicated that environmental damage was not as great as initially expected. A small loss of habitat in marsh grass areas resulted, but finfish and benthic organisms did not appear to be severely affected.

The U.S. Fish and Wildlife Service estimated that 20,000 birds died as a result of this incident. A total of 8,469 dead waterfowl, mostly Horned Grebes and Old Squaw, were recovered. Forty-six dead Whistling Swan, an endangered species, were recovered. Several problems were experienced in the cleaning of live, oiled waterfowl: volunteer groups were given little or no direction or assistance in their efforts to save the birds; and the contingency plan for the area did not include provisions for bird cleaning operations. Under the National Oil and Hazardous Substances Pollution Contingency Plan, the Department of Interior's representatives and state liaison to the Regional Response Team were assigned the task of waterfowl rehabilitation. Due to poor planning and coordination by the predesignated agencies, the OSC, who did not have lead responsibility for bird cleanup operations, was constantly questioned by the public and media about bird cleanup operations.

References:

- Hershner, C. and Moore, K. 1977. Effects of the Chesapeake Bay Oil Spill on Salt Marshes of the Lower Bay, Oil Spill Conference Proceedings, 1977, pp. 529-533.
- Roland, et al. 1977. The Chesapeake Bay Oil Spill-February 2, 1976: A Case History, Oil Spill Conference Proceedings, 1977, pp. 523-527.
- USCG On-Scene Coordinator's Report

Name of Spill: *Tamano*
Date of Spill (mmddyy): 07/22/72
Location of Spill: Casco Bay, Maine
Latitude: 43 40 N
Longitude: 70 10 W
Oil Product: No. 6 Fuel Oil
Oil Type: Type 4
Barrels: 2,380
Source of Spill: Tank Vessel
Resources at Risk: Clams, Oysters, Lobsters, kelp, marshes, coarse sand beaches, sand/gravel beaches, diving coastal birds, waterfowl, worm beds, demersal fish, power plant water intakes, commercial fisheries.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Closure of shipping lanes or vehicle traffic routes, wildlife rehabilitation.
Shoreline Types Impacted: Sand/gravel beaches, coarse sand beaches.
Keywords: Atlantic Strike Team (AST), sorbent boom, boom, skimmer, vacuum truck, hay, manual removal, high-pressure warm water washing, disposal.

Incident Summary:

In the early morning of July 22, 1972, the tanker *Tamano* grounded on Soldier's Ledge in Casco Bay, Maine, tearing a 20-foot hole in a starboard tank. The tanker continued to its anchorage in Casco Bay before the leak was noticed. The tanker was carrying 550,000 barrels of No. 6 Fuel Oil, 2,380 barrels of which spilled into Casco Bay. The Captain of the Port (COTP), Portland, Maine, was the On-Scene Coordinator (OSC) for the incident. The response ended on October 16.

Behavior of Oil:

No. 6 fuel oil is a heavy product with an API gravity that ranges from 7 to 14. Due to the prompt action of the vessel pilot in getting the tanker boomed most of the spilled oil was contained. Of the 2,380 barrels of oil that leaked from the vessel, 1670 were recovered from within the boom. *Oil impacted 46 miles of mainland beaches.* All the islands in Portland Harbor were oiled.

Countermeasures and Mitigation:

Transfer of oil from the ruptured tank began immediately upon discovery of the leak. The pilot of the tanker notified Sea Coast Ocean Services (SCOS) at 0215 that the vessel was leaking, and that booms were needed. SCOS responded immediately with booms and barges, and had the bow boomed by 0530. The OSC activated the Atlantic Strike Team (AST), and conducted overflights. The tanker was completely boomed by 0930 on July 22, and the situation appeared to be under control.

On July 23, it was discovered that the oil had moved under the boom and was surfacing some distance from the tanker. SCOS had insufficient response equipment available to handle the spill; the OSC contacted Texaco Inc. which had chartered the vessel from the Norwegian owner, Wilh Wilhelmsen. Texaco denied responsibility but agreed to temporarily fund the cleanup operations. The OSC hired more cleanup contractors, including SCOS. Skimming of the contained oil, and skimming of oil outside the containment boom began. *Hay spread on the uncontained slick proved effective as a herder and absorbent, but it clogged the skimmers.* Beach cleanup began on the mainland and island shores. Oiled hay and seaweed on the beaches were removed manually.

Oil recovery operations lasted two weeks. Skimming operations used a JBF Dynamic Incline Plane (DIP) skimmer, two T-T Oil Recovery Units, a 1000 Series Rheinwerft Skimmer, three Oleo III skimmers, and a Slurp Skimmer. *The Rheinwerft Skimmer worked most effectively, and the JBF DIP skimmer was satisfactory except for its small holding tank.* The other skimmers collected too much water along with the oil, and under rougher conditions than the ideal weather that the *Tamano* operations experienced, these skimmers would not have been seaworthy.

Booms deployed included 13,700 feet of 36-inch T-T boom, 1200 feet of 6-inch Slick Bar boom, 300 feet of 3-foot Uniroyal boom, and 800 feet of 15-inch Coastal Service boom. The T-T boom was used as the primary containment boom, and in the skimming of the free slick. This boom proved effective for containment, but had to be tended at all times. The *6-inch Slick Bar boom* was used in collecting oil in the Long Island area, and *was not effective.* The 3-foot Uniroyal boom was used effectively in skimming operations. The 15-inch Coastal Service boom was used effectively inside the larger containment boom for coralling the oil towards skimmers. Six vacuum trucks deployed on barges were also used to pick up the contained oil.

Two *Hydroclean Rock Washing units* were used on Long Island and Cape Elizabeth. One unit was deployed from a barge at one area and the other from a trailer at the other area. *The unit* was effective in washing the rocks, but *would have been more effective if used when the oil was fresher.* Booms and absorbent pads were used to collect the sheens resulting from the washing operations.

Additional pumps were brought on board the *Tamano* to expedite the transfer of oil from the leaking tank which was completed on July 25. Lightering of the *Tamano* was completed on August 3, and the tanker sailed for dry dock the next day. The owners assumed responsibility for the cleanup costs on August 11.

Western Beach on Long Island was heavily impacted by oil. Cleanup operations involved the removal of 6 inches of sand from a 100-foot by 2,300-foot strip of beach. *Tracked and rubber-tired vehicles had trouble operating on the beach, and occasionally became stuck in the oiled sand and gravel.*

The slick reached the Cousin's Island power plant water intakes. The intakes had been boomed as a precautionary measure, so no impacts occurred.

By October 4, the cleanup was mostly completed except for removal of accumulated oily debris. Some of the 46 miles of oiled shoreline was remote from the Portland area where operations were based. Due to the expense of transporting personnel and equipment to these areas, the OSC requested that each local town's public works departments pick up the oiled debris from their own beaches. Each town was reimbursed for their costs.

Operations were delayed until a dump site for the oiled debris was found. On August 3, a suitable site was found in Gray, Maine, and most of the debris was sent there. Oiled sand and gravel were used in construction at the Brunswick Naval Air Station.

Other Special Interest Issues:

The shipping lanes were closed to all traffic, because the wakes of passing vessels disturbed the containment booms. The OSC requested that the Army Corps of Engineers survey the sound for uncharted obstructions. No obstructions were found, and the lanes were opened again on August 4.

Clam harvesting was closed by the United States Public Health Service. Worm digging, and whiting, flounder, and herring fisheries were also affected.

Many oiled birds were found, and attempts were made to clean them. Among the birds affected were: Eider Ducks, White-Winged Scoters, loons, Common Terns, Common Scoters, Guillemots, Herring Gulls. Heavily oiled birds were humanely killed. Of the 34 Eider Ducks that were cleaned, only 10 survived. After a week, the Maine Fish and Game Department advised the public to stop bringing in oiled birds for cleaning. *It was believed that birds that had survived in an oiled condition for a week would survive the oiling without cleaning.*

Vast Inc. was hired by the U.S. Environmental Protection Agency (EPA) to study the ecological damage from the spill.

References:

- Bianchi, R., Johanson, E., Farrel, J. 1975. Use of the Massachusetts Dip Oil Skimmer on Free Slicks in the Casco Bay (Portland) Spill, Oil Spill Conference Proceedings, 1975, pp. 643-655.
- Eidem, C., Fitzpatrick, E., Conlon, J. 1975. The Casco Bay Oil Spill: Problems of Cleanup and Disposal, Oil Spill Conference Proceedings, 1975, pp. 217-221.
- USCG On Scene Coordinator's Report

Name of Spill: *Tanio*

Date of Spill (mmddyy): 03/07/80

Location of Spill: Brittany, France

Latitude: 49 10 N

Longitude: 004 16 W

Oil Product: No. 6 Fuel Oil

Oil Type: Type 4

Barrels: 98,955

Source of Spill: Tank Vessel

Resources at Risk: Commercial fisheries, anadromous fish, oysters, crabs, clams, abundant beds, designated harvest sites, reserves, shorebirds, diving coastal birds.

Dispersants: Yes

Bioremediation: No

In-situ Burning: No

Other Special Interest: Wildlife impacts, wildlife rehabilitation, habitat impact due to oil, volunteer response and organization, complex salvage operations, effects to tourism, closure of public lands.

Shoreline Types Impacted: Sand/gravel beaches, flats, marshes.

Keywords: Skimmer, vacuum truck, manual removal, high-pressure washing, sorbents, Finasol OSR 2, International Tanker Owners Pollution Federation (ITOPF), sinking, contingency plan, suction operations.

Incident Summary:

On March 7, 1980, the tanker *Tanio*, carrying 190,580 barrels of No. 6 fuel oil, broke in two off the coast of Brittany, France during a violent storm. The master and seven crew members died as a result of the accident.

Approximately 98,955 barrels of oil spilled into the sea as a result of the breakup. The bow section, which still contained 36,650 barrels of oil, sank in 300 feet of water. Substantial amounts of oil continued to leak from the sunken bow until several small leaks in the bow were sealed in May. The stern remained afloat and was towed to the port of Le Havre where its remaining 54,975 barrels of oil were offloaded.

Strong northwest winds at the time of the incident moved the oil towards the Breton coast. Due to the high viscosity of the oil and severe weather conditions, containment or dispersal at sea was impossible. Because the spring tides in this region have an average tidal range of 26 feet, many areas along the coast could not be boomed effectively. Consequently, the Breton coast (which had already received major oil impacts from the *Torrey Canyon* spill in 1967 and the *Amoco Cadiz* in 1978), was again severely oiled.

Approximately 45 percent of the *Amoco Cadiz* spill area was affected by oil from the *Tanio*. Approximately 125 miles of the coastline of the two Departments of Finistere and Cotes-du-Nord were oiled.

Both Departments implemented the Plan Polmar, the French national oil spill contingency plan, due to the severity of the coastal oiling. This enabled them to use the national army for cleanup operations. Personnel from the Civil Defense organization, fire service, local governments, commercial

contractors, and local farmers were also involved in the cleanup. The International Tanker Owners Pollution Federation (ITOPF) provided technical advice and monitored cleanup activities on behalf of the International Oil Pollution Compensation (IOPC) Fund. Cleanup operations in the two Departments varied due to differences in the severity of the pollution, nature of the shoreline, and the cleanup policies that were implemented. Cleanup was completed and all beaches except St. Guirec were in use by early July. Damages and costs incurred during cleanup exceeded \$50 million.

Behavior of Oil:

No. 6 fuel oil is a heavy product with an API gravity that ranges from 7 to 14. The oil first came ashore on March 9, with the bulk of oil impacting the shore on March 10. The Cotes de Granit Rose area to the east of Perros-Guirec and the north- and northwest-facing beaches and bays in the Tregastel and Ploumanac'h vicinities were the most heavily affected. The pink granite rocks in these vicinities as well as in St. Guirec in Cotes-du-Nord were severely oiled. Several small boats, primarily in the Ploumanac'h region, were contaminated. By March 11, patches of oil and heavy streaks of sheen were observed by aerial reconnaissance to be moving out of the bays in an easterly direction. High tides and changes in wind direction over the following two weeks redistributed the oil on the coast. *In all, about 125 miles of shoreline with a large tidal range of 26 feet was oiled.*

A 1983 survey found remnants of oil along high-energy gravel shores in tarry blotches on rock surfaces, asphalt-like layers above the active intertidal zone, and mobile oil in a small number of sheltered, coarse-grained sediments. *Notable oil persisted in the sediments five years after the incident.*

Countermeasures and Mitigation:

Boom was deployed at Carport on the Jaudy River to protect trout and salmon fisheries in the area. By March 12, the Ile Grande marsh and the Trieux River near Lezardrieux were boomed. Boom was also installed across the Leguer River to protect Lannion. Ten priority areas were boomed and monitored by a specialist team from the Navy. Strong currents generated by the large tidal range reduced the effectiveness of the booms, requiring the use of strong boom that took several days to deploy. Approximately 13,000 yards of boom were deployed in Cotes-du-Nord and 3,500 yards in Finistere.

Plastic sheets were used to cover promenades, jetties, walls, and sand at the top of several beaches in the Cotes-du-Nord Department.

An *Egmolap skimmer* collected oil at the entrance of Ploumanac'h. In general, *vacuum systems did not work well because the hoses became blocked with stones and seaweed.* A *Rolba beach cleaning machine* picked up pellets of oily sand on Greve de Goulven in Finistere. A knife edge on the machine scraped across the sand and then placed the oil and sand into a vibrating and rotating screen. The sand then dropped back to the beach while the oil lumps

moved on to a collection bin. This machine only worked on beaches with good access and hard-packed sand that could support the weight of the vehicle.

Tractor-drawn vacuum trucks removed oil on warmer days; on cold days the oil was too viscous. Due to the oil viscosity and the concern that the next tide would rapidly spread the pollution, *bulldozers* and *front-end loaders* were employed to quickly remove the bulk of the oil. Although much oil was removed in a short time, the extensive use of bulldozers and front-end loaders pushed the oil into the underlying sediments at a number of beaches. This sub-surface oiling required extensive restoration work later.

Shovels were used to reach areas where the oil was thin or hard to access. Collected oil was put into sacks or tractor-drawn trailers for transport to a tanker-deballasting station.

Approximately 20,000 tons of oily sand and debris were collected in Finistere. At the *tanker-deballasting station* in Brest, the collected material was mixed with *quicklime* to produce a dry inert material for use as fill in roads and hard standings. Approximately 1,800 tons of liquid material was collected in Cotes-du-Nord and transported to the deballasting station. The 34,000 tons of oiled sand and debris collected in the Cotes-du-Nord area was deposited in *storage pits* behind the beaches, where quicklime was mixed into the material using mechanical trenchers. This new mixture was then transported to secondary treatment and disposal sites.

Medium-pressure, hot-water washing machines and *high-pressure, cold-water jets* delivered from high-capacity pumps were used to wash oil from the rocks in the tourist areas. Around 390 hot-water washing machines were used in Cotes-du-Nord while 200 were used in Finistere. To help collect the oil washed from the rocks, cleanup crews in Finistere applied *granular mineral sorbents*, primarily *Ekoperl 33*, to the oil before washing it off. This oil/sorbent mixture was then collected from the base of the rocks. In Cotes-du-Nord, considerable amounts of *dispersants* were used to help remove the oil from the rocks. In some instances, undiluted dispersant, mainly *Finasol OSR 2*, was applied to the oil on the rocks and then washed off with cold water. In other cases, pre-mixed solutions of 0.5 to 1 per cent concentrated *Gamlen Sybrom OSR 2000* or *Hydrosol DN40* dispersants were used directly in the water wash. Over 50,000 gallons of dispersants had been applied by May 22.

Although the leaks on the sunken bow had been sealed, the French government decided to *pump the remaining oil out of the sunken bow section*. This difficult operation took until August 1981 to complete. Strong currents and inadequate equipment slowed the operation.

Other Special Interest Issues:

A number of areas, including Roscoff, Kerfissien, and Loquivy sur la Mer, reported shellfish losses. Loquivy lost approximately 60 tons of crabs, clams, and winkles due to oil contamination on March 15 to 16. Oyster beds were contaminated at Plougrescant and Loquenole on the Morlaix River. Seaweed harvesting along the coast of Ile de Brehat, Point de l'Arcouest, and Sillon de Talbert was disrupted during the cleanup. Due to the nearby Les Sept Iles seabird reserve, approximately 1,700 dead birds, primarily guillemots and other auks, were recovered during the incident. Volunteer clinics were set up at Trebeurden, Saint Michel-en-Greve and Pleneuf Val Andre to clean the less severely oiled birds.

References:

- Ganten, R.H. 1985. The Tanio Spill: A Case History Illustrating the Work of the International Oil Pollution Compensation Fund, Oil Spill Conference Proceedings, 1985, pp. 135-139.
- Genwest Systems, Inc. communications with ITOPF representatives.
- Gundlach, E. and Marshall, M. 1990. The Physical Persistence of Spilled Oil: An Analysis of Oil Spills Previous to Exxon Valdez. Final Report. HAZMAT. OAD. NOAA. pp.47-68.
- Hooke, N. Modern Shipping Disasters 1963-1987. Lloyds of London Press. 1987.
- OSIR Oil Spills, International Summary & Review, 1978-1981
- Review of Oil Spill Occurrences and Impacts, Exxon Production Research Company, 1989.

Name of Spill: *Tarik Ibn Ziyad*
Date of Spill (mmddyy): 03/26/75
Location of Spill: Rio de Janeiro, Brazil
Latitude: 22 54 S
Longitude: 043 10 W
Oil Product: Crude Oil
Oil Type:
Barrels: 109,950
Source of Spill: Tank Vessel.
Resources at Risk: Mangroves, crabs, commercial fishing, industrial water intakes, shrimp, recreational beaches, wildlife preserves.
Dispersants: Yes
Bioremediation: No
In-situ Burning: Yes
Other Special Interest: Habitat impact due to oil.
Shoreline Types Impacted: Mangroves, sand/gravel beaches, piers.
Keywords: Straw, skimmer, boom, manual removal, sub-surface oil, fire, International Tanker Owners Pollution Federation (ITOPF).

Incident Summary:

The *Tarik Ibn Ziyad* grounded on March 26, 1975 while entering the Sao Sebastiao terminal at Santos, Brazil. Tanks ruptured and the vessel leaked oil for approximately 15 hours.

Behavior of Oil:

Oil impacted beaches at Governador Island, Bananal, Freguesia, Pitangueriras, Bandeiras, Engenhoca, Jardim Guanabara, and the Island of Fundao. Oil was accidentally ignited on the Island of Fundao. Oil entered the Jequia River, heavily oiling the biological preserve there. The oil in the preserve caught fire and destroyed mangrove trees.

Countermeasures and Mitigation:

The State Environmental Engineering Foundation (FEEMA) coordinated the spill response of which the Ministry of the Navy, the Municipal Street Cleaning Company (COMLURB) of the municipality of Rio de Janeiro, and Petroleo Brasileiro (PETROBRAS) were the principal participants. Overflights from helicopters supplied by the Navy began within five days to monitor the movement of the oil. Application of dispersants, and the use of straw as an absorbent were the two principal cleanup techniques. Skimmers and 440 yards of boom supplied by PETROBRAS were deployed in the Jequia Channel.

Cleanup operations on the beaches were conducted by COMLURB and included the spreading of straw as an absorbent, and some applications of dispersant. Oil soaked straw was removed manually.

Cleanup response lasted until April 6, 1975.

Other Special Interest Issues:

The dispersant P-69 was sprayed on the slicks and on oiled docks. On open water slicks the dispersant caused the oil to emulsify and sink to a depth of 3 to 6 feet. The submerged emulsion leaked oil back to the water surface.

Oil in the Jequia River biological preserves caught fire, and destroyed approximately 24,000 square yards of mangroves.

References:

- Genwest Systems, Inc. communications with ITOPF representatives.
- MMS Worldwide Tanker Spill Database

Name of Spill: *Tenyo Maru*

Date of Spill (mmddyy): 07/22/91

Location of Spill: Neah Bay, Washington

Latitude: 48 28 N

Longitude: 125 18 W

Oil Product: Intermediate fuel oil, diesel oil, lube oil, bilge oil, fish oil.

Oil Type: Type 2, Type 3

Barrels: 7,143

Source of Spill: Non-Tank Vessel

Resources at Risk: Exposed rocky shores, sand/gravel beaches, kelp, whales, seals, sea otters, sea lions, diving coastal birds, waterfowl, alcids, shorebirds, wading birds, gulls, terns, raptors, anadromous fish, demersal fish, oysters, mussels, clams, mollusc harvest areas, crabs, high-use recreational fishing areas, State Parks, beaches, National Parks, subsistence, commercial fisheries, Native American Lands.

Dispersants: No

Bioremediation: No

In-situ Burning: No

Other Special Interest: Adverse weather conditions, closure of public lands, closure of recreational fishing areas, interaction with foreign or Native authorities, unusual or experimental cleanup techniques, wildlife impacts,

Shoreline Types Impacted: Exposed rocky shores, sand/gravel beaches.

Keywords: Collision, remotely operated vehicle (ROV), boom, skimmer, suction operations, International Bird Rescue Research Center (IBRRC), pompoms, sorbents, manual removal, sinking.

Incident Summary:

At approximately 0815 on July 22, 1991, the fish processor vessel *Tenyo Maru* and the Chinese freighter *Tuo Hai* collided in the Pacific Ocean, approximately 20 miles west of Cape Flattery, Washington, and 20 miles south of Vancouver Island, British Columbia, Canada. Ten to fifteen minutes after the collision, the *Tenyo Maru* sank in an estimated 350 feet of water. The *Tenyo Maru*, carrying **6,500 barrels of intermediate fuel oil, 2,166 barrels of diesel oil**, and some quantity of lube, bilge and fish oils, began leaking oil shortly after it sank. There were conflicting reports of the weather at the time of the collision, several reports claiming that the weather was clear, while others maintained that it was foggy.

The incident occurred in Canadian waters very near the Canadian/United States boundary. The Canadian Coast Guard (CCG) and the United States Coast Guard (USCG) implemented the Canadian/U. S. Joint Marine Pollution Contingency Plan. Since the spill occurred in Canadian waters, the CCG took the lead role in coordinating the spill response. Ultimately, the majority of shoreline oiling occurred in the United States. The USCG federalized the U.S. cleanup effort, accessing funding through the Oil Spill Liability Trust Fund, on July 30 when the owner of the *Tenyo Maru* discontinued funding the cleanup.

The *Tenyo Maru* continued to leak oil after it sank, with the largest amount released shortly after the sinking. Response to the incident continued into late August. The bulk of the response effort was scaled down by August 29, as the amount of oil being released from the sunken vessel on a daily basis had reduced significantly. The Canadian and U.S. Coast Guard planned to monitor the spill site for at least another month with regularly scheduled overflights and beach surveys as warranted.

Behavior of Oil:

Oil released from the sunken vessel was carried southeast by currents and wind. Observations made from overflights the day after the sinking indicated that the leading edge of the oil slick was approximately 22 nautical miles west of Cape Flattery and 7 nautical miles south of the spill site.

Within a few days after the sinking oil began to wash ashore at points along the Washington coast. Oil was first observed at Shi Shi beach, Cape Flattery, and the area between Tatoosh Island and Rialto Beach, with the heaviest impacts at Shi Shi. Shoreline impacts were also observed at Hobach Beach, Sooes Beach and Cape Alava. These impacts were generally light and consisted of scattered bands of tarballs and oiled debris.

Oil also impacted beaches within Olympic National Park in Washington. As a result, *park rangers closed several beaches and trails* along the affected areas, including the area between Sands Point to the Waatch River, and the Ozette and Cape Alava hiking trails.

Initially, the Tenyo Maru released oil at a rate of about 100 barrels a day. That rate had decreased by July 28. On July 31 it was estimated that the amount of oil released from the *Tenyo Maru* up to that point was less than 2,380 gallons. The oil slick had spread over a large area, with the leading edge of the oil at approximately 80 miles from the source, or about 20 miles west of Ocean City in northern Oregon.

By August 8, scattered sheen and tarballs had reached Fort Stephens State Park in northern Oregon. These oil impacts were removed by a storm the same day. Some oil was also reported at Seaside and at Cannon Beach in Oregon. As a result, these beaches were briefly closed to recreational vehicles and shellfishing.

Oil surfacing from the vessel generally had the appearance of rainbow sheen. Later the oil would coalesce into dark patches with sheen, tarballs, and occasionally mousse. The oil would generally tend east from the source for several miles and then begin to head south. Some of the oil continued east into the Strait of Juan de Fuca, and oiled beaches along the northern tip of the Olympic Peninsula. *Tarballs and sheen were sometimes held offshore in kelp beds and beaches would then be re-oiled when the tide changed.*

On August 9, very small amounts of oil were found on a beach at Green Point in the Pacific Rim National Park in southern British Columbia. In addition,

light oiling was found along five Canadian beaches between Tofino and Ucluelet on August 13 and 14, and light oiling was observed on Effingham and Wouwer islands, also in British Columbia.

Countermeasures and Mitigation:

Oil tracking and skimming operations were periodically hindered during the response effort by foggy weather.

Skimmers arrived on-scene from Canadian and U. S. sources. Skimming operations took place around the spill site, and in other areas where concentrated patches of oil were located. Skimmers attempted to collect oil at the leading edge of the slick when the oil was approximately 80 miles from the source, but had limited success due to the dispersed nature of the slick. In general the skimmers worked well, but had difficulty collecting some of the light sheen, especially in heavy seas or when the oil was too thinly spread over the water. *The total oil/water mixture collected by July 31 was about 714 barrels.*

Two tugs were used to deploy the CCG's *Ro-boom* to assist with skimming operations. The *Ro-boom* was manufactured by Roulunds from Denmark. *Ro-boom* was towed in a V-configuration between the two tugs so that the oil would be concentrated for the skimmers. Manufacturer specifications for the boom claimed that the boom could work in 12 foot seas and at current speeds of up to 1.5 knots. In some cases, it was found that the *Ro-boom did not work well in high seas or when towed at high speeds*. The tugs utilized for towing the boom were not designed to operate at very slow speeds, and it was suggested that vessels with variable pitch propellers would have worked better under these conditions.

Sensitive clam beds in Neah Bay were boomed on July 30 and a boat cleaning station was established in the Neah Bay harbor.

Shoreline cleanup took place on Sooes Beach, Shi Shi Beach, Cape Alava, and other affected areas along the Washington coast. Beach crews used *sorbents, rakes, and shovels*, manually collected oily debris, and in some cases, *scrubbed oiled rocks*. In addition to the manual cleanup, *pompoms were strung together and deployed along the intertidal zone. This passive method of oil collection was reported to have worked very well*. A portion of the Makah Reservation land at Tatoosh Island and Cape Flattery was cleaned by Makah Tribe members, supervised by the cleanup contractors. Federal, state and Tribal representatives worked closely throughout the spill to find the best solutions to removing oil from Native lands with minimum impact on cultural areas. Similarly, tribal council members from the Nuu-Chah-Nulth tribe in British Columbia removed oiled debris from beaches in the area between Tofino and Ucluelet in British Columbia. *By mid-August, beach cleanup crews had collected a total of about 35,000 bags of oily debris.*

Beginning on August 3, the CCG began using an *unmanned remotely operated vehicle (ROV)* to survey the sunken *Tenyo Maru*. A manned

submersible was not used due to the risk of entanglement in the wreck. Surveys indicated that the vessel was lying on a silt layer in the ocean floor and that it had a considerable amount of debris (fishing nets, rigging, fallen masts) in its vicinity. In addition, it was discovered that the oil leaking from the vessel was pouring out from two portholes on the ship's bow. By August 14, the CCG was able to use the ROV, with its mechanical arms, to insert a 3-inch diameter suction hose into one of the sunken vessel's portholes, and begin pumping oil from the vessel. The ROV was also used to secure the hose with an anchor so that it would not be dislodged during pumping. The pumping platform had a 14,000 gallon capacity storage tank for storing the oil/water mixture pumped up from the vessel. *The pumping operations were very successful.*

The pumping operations continued until August 27, with a total volume of over 120,000 gallons of an oil/water mixture collected. Approximately 25,000 gallons of this was oil. Pumping operations were suspended because the amount of oil leaking from the vessel, and the oil recovery rate from pumping, decreased markedly by the second week. It was estimated that less than 50 gallons of sheen was released from the vessel the day after pumping operations ceased.

Skimming operations were suspended on August 20, with some of the skimmers waiting on standby in case the rate of oil leakage from the vessel increased. It was estimated that all the fuel tanks on board the *Tenyo Maru* had been ruptured when the vessel sank. As a safety measure, U.S. and Canadian Coast Guard personnel observed the vessel for another month, conducting about four overflights per week, after the cleanup effort had been scaled down.

Other Special Interest Issues:

It was noted that several other vessels used the *Tenyo Maru* oil spill as an opportunity to dump waste oil illegally into already oiled waters.

By mid-August, approximately 800 live oiled birds and 3,700 dead oiled birds had been recovered. The majority of the birds recovered were Common Murres, but other birds collected included Tufted Puffins, Rhinoceros Auklets, Pigeon Guillemots, Marbled Murrelets, loons, gulls, terns, and scoters. The International Bird Rescue Research Center (IBRRC) operated a bird care facility at St. Edwards State Park in Washington during the spill. Two emergency care stations were established close to the spill site to house and stabilize birds until they were ready to be transported to the bird cleaning center.

References:

- Golob's Oil Pollution Bulletin; World Information Systems and the Center for Short-Lived Phenomena; 2 August 1991; Vol. III, No. 16.
- Golob's Oil Pollution Bulletin; World Information Systems and the Center for Short-Lived Phenomena; 16 August 1991; Vol. III, No. 17.
- Golob's Oil Pollution Bulletin; World Information Systems and the Center for Short-Lived Phenomena; 30 August 1991; Vol. III, No. 18.
- Marine Response Bulletin; Marine Digest; September 19, 1991; Vol. 1, No. 6.
- NOAA Hotline Reports
 - Oil Spill Intelligence Report; Cutter Information Corp.; 1 August 1991; Vol. XIV, No. 29.
 - Oil Spill Intelligence Report; Cutter Information Corp.; 15 August 1991; Vol. XIV, No. 31.
 - Oil Spill Intelligence Report; Cutter Information Corp.; 22 August 1991; Vol. XIV, No. 32.
 - Oil Spill Intelligence Report; Cutter Information Corp.; 25 July 1991; Vol. XIV, No. 28.
 - Oil Spill Intelligence Report; Cutter Information Corp.; 29 August 1991; Vol. XIV, No. 33.

Name of Spill: Texaco Storage Tank
Date of Spill (mmddyy): 04/27/86
Location of Spill: Bahia Las Minas, Panama
Latitude: 09 40 N
Longitude: 079 05 W
Oil Product: Venezuelan crude, Mexican Isthmanian crude
Oil Type: Type 3, Type 3
Barrels: 240,000
Source of Spill: Facility
Resources at Risk: Mangroves, coral reefs, eelgrass beds, molluscs, crustaceans, crabs.
Dispersants: Yes
Bioremediation: No
In-situ Burning: No
Other Special Interest: Research conducted, habitat impact due to oil, habitat impact due to cleanup operations.
Shoreline Types Impacted: Mangroves, coral reefs, sand/gravel beaches, eelgrass beds.
Keywords: Skimmer, vacuum truck, Corexit 9527, pressure washing, reoiling, manual removal.

Incident Summary:

On April 27, 1986, a Texaco storage tank at a refinery near Isla Payardi, Panama, ruptured, releasing approximately 240,000 barrels of medium-weight crude oil. Some of the oil was contained within dikes at the facility. Approximately 140,000 barrels of oil flooded through a dike and overflowed separators and a retaining lagoon and flowed into Bahia Cativa. Refinery personnel reported that a total of 60,000 barrels of oil were recovered. It is not known how much of this recovered oil was from the sea.

Behavior of Oil:

Isthmus crude oil has an API gravity of 32.8, and a pour point of 10 degrees F. Onshore winds initially confined the spill within Bahia Cativa, adjacent to the refinery. On May 3, winds and rain runoff pushed much of the oil out to sea, beyond a containment boom at the mouth of the bay. Once the spill was no longer contained, dispersant application began.

The distribution of oil was surveyed from aircraft for two months following the release. Surveys covered the area between Rio Chagres, 17 miles to the west, and Punta San Blas, 61 miles to the east of the refinery. During the surveys, the degree of oiling was assessed visually and quantified as heavy, moderate, light, or absent. Also noted during the surveys were the habitat types and organisms affected by the oil.

By May 15, the oil was contaminating fringing reefs, sand beaches, mangroves, and estuaries within 6 miles of the refinery. Heavy oiling was reported along much of the shoreline between Isla Margarita and Islas Naranjos. Two partially isolated lagoons with entrances facing the northwest

were spared the effects of heavy oiling. *A total of 51 miles of shoreline was heavily oiled.* Oiled shorelines within this distance included extensive mangroves, intertidal reef flats, seagrass beds, and subtidal coral reefs. Little of the oil was spotted west of the Panama Canal entrance or east of Maria Chiquita.

The most heavily oiled habitats were those closest to the refinery. Concentrations of beached oil were highly variable within each habitat type. Variable oiling was likely due to variation in distance from the spill source, water depth, and directional orientation of the shoreline. Shorelines facing north or northeast were the most severely affected since much of the oil that escaped from Bahia Cativa moved to the west. Shorelines that faced the south or west tended to be less heavily oiled. Low tides between May 10 and 19 resulted in the oiling of the seaward reef flat margins. As a result of the low tides, the heaviest accumulations of oil were observed in the intertidal areas slightly above mean low water. Habitats impacted included mangroves, seagrass beds, coral rock, and beaches. Small-scale patchiness was also observed visually and among replicate samples of the surface sediments.

Reoiling of the shoreline and mangroves was a continuing problem. *Oil slicks were regularly observed within Bahia Las Minas for at least four years following the spill* with oil coming predominantly from the areas of the fringing mangroves. It is believed that as the red mangrove trees (*Rhizophora mangle*) that were killed by the oiling decay, the erosion of the underlying sediments released trapped oil. *Some observed oil appeared to originate from the landfill beneath the refinery.*

Countermeasures and Mitigation:

The deployment of boom across the mouth of Bahia Cativa helped contain the spilled oil during the first six days of the incident. When wind and rain water run off pushed the oil out of the bay, dispersant application was begun.

Approximately 132 barrels of the dispersant *Corexit 9527* were applied from aircraft. Dispersant application took place in Bahia Cativa, Islas Naranjos, offshore of Bahia Las Minas, near Portobelo, and along the northern breakwater at the mouth of the Panama Canal. *The dispersant application appeared to be ineffective due to the weathered state of the oil and the calm seas.*

Floating oil was recovered by *skimmers*. *Vacuum trucks* were used as part of the shore-based cleanup effort. Several channels were dug through the mangroves in an effort to drain the oil. These *channels* appeared instead to have the *detrimental effect of aiding the movement of the oil inshore.* Increased disturbance due to the construction of the channels may have also contributed to subsequent erosion. *Manual removal* of oiled rocks and debris was conducted along the more accessible shorelines. *Seawater was sprayed on some sandy areas to aid oil removal.* The recovery of floating oil by pumping appeared to be the most effective oil recovery method. The shallow waters

and mangroves made many of the typical oil spill cleanup techniques impractical.

Other Special Interest Issues:

Many of the affected shoreline habitats were sites of ongoing study by the Smithsonian Tropical Research Station at Punta Galeta. A great amount of research has been conducted in the affected areas since the spill. Historical time-series data on the biota and physical conditions greatly aided the documentation of the pre-spill conditions.

The first heavy oiling of the Punta Galeta area occurred on May 9. Although the oil had weathered for 12 days, it was still fluid, and had the appearance of used crankcase oil. The heaviest oiling occurred along the seaward side of the reef flat at low tide. Organisms within a 6-meter wide zone were directly immersed in oil, and included zoanthids, corals, and calcareous and fleshy algae. A systematic visual survey determined that less than 10 percent of the original sessile community survived the oiling. None of the crabs that normally inhabit this zone were found. Some live crabs (*Grapsus grapsus*) that were found on nearby emergent structures appeared to be blind.

By June, patches of oil remained in some areas of the reef flat. Algal growths showed no visible damage in the deep tide pools, but were much less abundant on emergent substrates than before the oiling. Some areas of coralline algae and active crab burrows were bare of algal growth. Microalgae quickly colonized the vacant substrate created by the mortality of other organisms.

The short-term effects of the oil on the common shallow subtidal corals were studied. The number of corals, total coral cover, and species diversity decreased significantly with increased oiling. The greatest decrease in percent cover was found in the large branching coral *Acropora palmata*. Growth of three species of massive corals was less on oiled reefs during 1986, than the average of the nine previous years.

A study of mangrove trees revealed that one- to two-year-old seedlings appeared to survive where the surrounding adults died. It was believed that somehow, young seedling structure (perhaps lack of prop roots) enabled the young trees to tolerate periods of oil immersion. It was suggested that the disruption of the substrate before replanting may remove such survivors, hampering forest recovery. Oil persisted in the mangroves through May 1989. Initial oiling of the trees produced measurable amounts of oil on 100% of all the roots that were sampled. Through May 1989, the mangrove roots in the open coast and channel areas showed 70 percent oiling, while the oiled proportion in the stream mangroves remained 100 percent. The decrease in oil coverage resulted from weathering, microbial degradation, and loss of oiled bark or encrusting organisms. Observed root mortality was greater in oiled areas.

References:

- Keller, Brian D. and J.B.C. Jackson, eds. 1991a. Long-term assessment of the oil spill at Bahia Las Minas, Panama, interim report, volume I: executive summary. OCS Study MMS 90-0030. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Regional Office, New Orleans, La. 48 pp.
- Keller, Brian D. and J.B.C. Jackson, eds. 1991b. Long-term assessment of the oil spill at Bahia Las Minas, Panama, interim report, volume II: technical report. OCS Study MMS 90-0030. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Regional Office, New Orleans, La. 48 pp.

Name of Spill: *Texas*
Date of Spill (mmddyy): 03/07/86
Location of Spill: Mile 43.4, Upper Mississippi River, between Missouri and Illinois
Latitude: 37 10 N
Longitude: 089 30 W
Oil Product: Western Crude Oil
Oil Type: Type 3
Barrels: 17,055
Source of Spill: Tank Barge
Resources at Risk:
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest:
Shoreline Types Impacted: Piers, vegetated riverbank.
Keywords: Boom, sorbents.

Incident Summary:

On March 7, 1986, the Tank Barges *Kansas* and *Texas*, under tow from the *M/V Edwin L. Kennedy*, ran aground on the Grand Chain Rocks at Upper Mississippi river mile 43.4 while en route to Garyville, Louisiana. The tow consisted of eight barges, all loaded with western crude oil. *Texas* and *Kansas* were the two barges at the front of the tow which included six other barges. The grounding occurred shortly after the pilot had navigated to clear the Thebes Railroad Bridge. While the *Kansas* appeared undamaged, the *Texas* sustained heavy damage to the bottom of its number 1-6 starboard and 1-3 port cargo tanks. USCG Group Upper Mississippi River was notified of the incident at 0308.

Early attempts to rig boom around the damaged barge failed due to rapid currents and river conditions. Ingram Barge Company of Nashville, Tennessee, the owner/operator of the *M/V Edwin L. Kennedy* and the *Texas*, hired Paducah Mutual Assistance Association (PMAA) as the primary cleanup contractor. The owner representative also participated in overflights to provide a better summary of the situation. Lightering operations of the *Kansas* began at 1400. By 0800, March 8, this barge floated free with no apparent damage. Lightering of the *Texas* began on March 8. At 1420, March 9, the barge was free and repositioned at mile 43.4 left descending bank. By 1615, the barge was drafting approximately five feet after ballasting. No evidence of further pollution was noted.

After a Permit to Proceed was issued to the *Texas*, the barge was allowed to continue on to New Orleans for offloading and repairs. Simpson Environmental Services of Port Natchez, Texas, was brought in as a second cleanup contractor. Soundings taken on March 12 revealed 17,055 barrels of oil were missing from the *Texas*. Cleanup operations were completed by March 28.

Behavior of Oil:

The incident occurred during high water, so the oil was carried into several landlocked areas. Product in the water appeared to weather and dissipate rapidly under the influence of river currents.

Extensive oiling between miles 43.3 and 39 was observed from a USCG overflight at 1100 on the day of the incident. The On-Scene Coordinator (OSC) noted extensive pollution on March 8 from mile 43.3 to mile 37.8 with moderate amounts below 37.8. These moderate amounts were inaccessible and midstream. Observers on a March 10 overflight noted pockets of oil in various areas from mile 37.2 to 7.3. A March 25 overflight conducted by the OSC revealed that cleanup in most of these areas was complete. Two small pockets of oil, one at mile 22.0 in the Upper Mississippi River and the other at mile 952 in the Lower Mississippi River, remained to be cleaned.

Countermeasures and Mitigation:

Boom placed around the barges after the grounding was ineffective due to river conditions and currents. An area downstream of the rock dike was boomed off to contain held oil. Trapped oil was then removed with *sorbents*. Containment boom was also deployed at mile 39.5 and mile 12.4 on the Upper Mississippi River, and across the mouth of the Cache River. Little or no observable effects to wildlife were noted.

Other Special Interest Issues:

Both the States of Missouri and Illinois were involved in the incident. The State of Illinois and other local authorities were mainly involved in assessment of damage and mitigation since the *T/B Texas* had been stored along the Missouri shore. The States representatives deferred to the OSC's judgment for conditional approval of cleanup.

References:

- USCG On-Scene Coordinator's Report

Name of Spill: *Torrey Canyon*
Date of Spill (mmddyy): 3/18/67
Location of Spill: Lands End, England
Latitude: 50 03 N
Longitude: 004 44 W
Oil Product: Kuwait crude oil
Oil Type: Type 3
Barrels: 860,000
Source of Spill: Tank Vessel
Resources at Risk: Abundant shellfish beds, shorebirds, waterfowl, diving birds, bird nesting beaches, oysters, crabs.
Dispersants: Yes
Bioremediation: No
In-situ Burning: Yes
Other Special Interest: Habitat impact due to cleanup operations, research conducted, wildlife impacts, wildlife rehabilitation
Shoreline Types Impacted: sand/gravel beaches, exposed rocky shores.
Keywords: BP1002, straw, chalk, bombing, manual removal, fire.

Incident Summary:

On the morning of March 18, 1967, the *T/V Torrey Canyon* ran aground on Pollard Rock on Seven Stones Reef off Lands End in England due to the master's negligence. The entire cargo, approximately 860,000 barrels (references range between 857,600 and 872,300 barrels), was released into the sea or burned during the next twelve days. Ships of the Royal Navy carrying detergents were en route to the scene within four hours of the grounding.

The response command post was established at Plymouth. The Royal Air Force and the Royal Navy implemented an early warning system for oil movement. A panel of expert scientists was assembled to consider scientific problems involved with the cleanup procedure. Local authorities were instrumental in dealing with the oil beached within their jurisdictions.

A detergent, primarily BP1002, was sprayed on much of the floating oil to emulsify and disperse it. Manual methods were used for removal of oil on many of the sandy beaches, although the dissected nature of the shoreline made it impossible to clean the whole coastline. The vessel lost structural integrity on March 26, releasing more oil into the water. Since towing the vessel off the reef was deemed impossible, the government decided to bomb the vessel.

Behavior of Oil:

Kuwait Export crude oil has an API gravity of 31.4, and a pour point of 0 degrees F. The spilled oil formed three distinct slicks. The first slick, composed of approximately 219,900 barrels, drifted up the English Channel, oiling the north coasts of France and Guernsey. The following week, about 146,600 more barrels escaped the vessel. Approximately 102,620 barrels of this second pulse stranded on 200 miles of the coast of West Cornwall. One

hundred miles of coastline between Perranporth and The Lizard, at the southern tip of Cornwall, were affected. The third slick, estimated at 366,500 barrels, formed on March 26 when the vessel broke up. This slick drifted south into the Bay of Biscay and remained at sea for two months, during which time as much as 50 percent of the lighter fractions of the oil evaporated. The west coast of Brittany was only lightly oiled.

The formation of water-in-oil emulsions, containing up to 80 percent water, greatly increased the volume of material and its resistance to dispersants. Approximately half of the cargo did not reach the shore because it weathered, evaporated, or was dispersed by natural mechanisms. For several months following the dispersant application, many shorelines were recoated with oil-dispersant mixtures.

Countermeasures and Mitigation:

Over 10,000 tons of detergents, primarily BP1002, which contained 12 percent nonionic surfactant and 3 percent stabilizer, were sprayed on the floating oil to emulsify and disperse it. Forty-two vessels were chartered for the spraying operation. Concentrations of 10 parts per million or less of these detergents were acutely toxic to many marine mammals and plants. Many limpets on intertidal rocks in the spray area were killed. A prodigious growth of green weed occurred due to enhanced nutrients from the dispersants. Detergents were not used on the 40-mile long coastal section between Trebeurden and Ile de Brehat so that inshore shellfish would not be contaminated with toxic components of detergents.

Manual removal methods, including the use of *straw* and *gorse* to soak up oil, were used on many of the sandy beaches on the north coast of Brittany. Cleanup operations included *pumping* and *bailing* of oil as well as *bulldozing* of oiled sand on the beaches. Over 1,400 personnel from the British armed services assisted with beach cleanup. Approximately 4,000 tons of oil and oil emulsions were removed from the foreshores of Guernsey and 4,200 tons were removed from French beaches.

The French treated floating oil with approximately 3,000 tons of *natural chalk* containing stearic acid which made the chalk oleophilic. It was believed that this chalk caused the oil to sink or disperse. The high density of the floating oil, the length of time the oil had been at sea, and relatively calm seas contributed to the apparent success of this method.

After considering the options of towing the vessel or attempting to pump oil off the vessel while it was still on the reef, government authorities decided to *bomb* the vessel to burn the remaining oil. The vessel was bombed by the Royal Navy on March 28-30 during periods of low water when the vessel was in clear view. A Navy helicopter dropped *napalm, sodium chlorate, and aviation fuel* to fuel the fire.

Other Special Interest Issues:

This incident prompted the English Government to take the initiative in organizing an early meeting of the Intergovernmental Maritime Consultative Organization to consider needed changes in international maritime law and practice. Relevant maritime laws were considered to be overly complex and out of date in many respects.

An estimated *25,000 birds died* as a result of the *Torrey Canyon* spill because the incident coincided with their northerly migration. The coasts of southern England and Brittany are nesting beaches for a variety of seabirds such as guillemots, razorbills, shags, puffins, and Great Northern divers. Thousands of *oiled birds* were picked up from the beaches for treatment, but *the survival rate was only around one percent* due to ingestion of oil, pneumonia, and improper handling and cleaning.

The *Torrey Canyon* incident was the first incident to draw universal attention to the *dangers of dispersants*. Extremely large quantities of dispersants were used during the response, clearly for aesthetic and not ecological purposes. *Contamination by oil without dispersants resulted in less adverse biological effect than where dispersants were used*. Many herbivores, mainly limpets, and some barnacles were killed due to the toxicity of the dispersant. Widespread mortalities on the West Cornish coast set the stage for a large-scale experiment on the development of a mature community, normally found on rocky shores, and the influence of herbivores and predators on the ecosystem. However, the resultant statistical comparisons may be somewhat inaccurate due to the small amount of pre-spill data, the lack of control sites where the oil was left totally untreated, and uncertainties of how much dispersant reached marginal areas. *Early estimates indicated rapid recovery of species along the beach, while long term studies revealed extremely slow recovery*. Wave-beaten rocky areas that received only light oiling took approximately 5-8 years to return to normal while areas receiving heavy and repeated dispersant applications took 9-10 years to recover. A 1978 study showed that a rare hermit crab species had not re-appeared in the spill area.

References:

- 1991 World Almanac
- 8/9/91 & 8/28/91 Letters from Daniel Owen at ITOPF
- Hooke, N. Modern Shipping Disasters 1963-1987. Lloyds of London Press. 1987.
- National Research Council. 1989. Using Oil-Spill Dispersants on the Sea. National Academy Press, Washington, D.C. pp.318-319.
- Oil on the Sea, David P. Hoult, 1969
- Potter, J. Disaster by Oil. Oil Spills: Why They Happen, What They Do, How We Can End Them. Macmillan Co., New York. 1973.
- Review of Oil Spill Occurrences and Impacts, Exxon Production Research Company, 1989.
- Tanker Advisory Center, Inc. 1991 Guide for the Selection of Tankers. T.A.C. Inc. 1991.
- The SocioEconomic Impacts of Oil Spills, Final Report, WAPORA, March 1984.
- The Torrey Canyon, Her Majesty's Stationary Office, April 1967
- Wilson, M.P. Jr., et al., "The Spreading, Retention and Clean-up of Oil Spills," URI, Kingston, RI, 1976.

Name of Spill: Trinimar Marine Well 327
Date of Spill (mmddyy): 08/08/73
Location of Spill: Gulf of Paria, Venezuela
Latitude: 10 30 N
Longitude: 062 00 W
Oil Product: Venezuelan crude oil
Oil Type: Type 3
Barrels: 36,650
Source of Spill: Platform
Resources at Risk:
Dispersants: Yes
Bioremediation: No
In-situ Burning: No
Other Special Interest:
Shoreline Types Impacted:
Keywords: Shell Dispersant L.T., International Tanker Owners Pollution Federation (ITOPF), blowout.

Incident Summary:

On the afternoon of August 8, 1973, the Trinimar Marine Well 327 blew out. Oil spilled from the well at a rate of 2,000 barrels per day until August 12 when the well sanded up.

Behavior of Oil:

An estimated 36,650 barrels of oil spilled from the well. Overflights on August 10, indicated slicks extending 6 miles to the WSW and 3 miles to the north. The slicks were comprised of patches of thin sheen. The majority of the oil travelled to the southwest until Icacos Point where dominant currents brought it into the center of the Gulf of Paria and through the North Bocas to the Atlantic Ocean. Oil impacted beaches from Irois Bay to Los Gallos Point. By August 17, the slick had dissipated.

Countermeasures and Mitigation:

On August 10, responders began pumping water into the well to lessen the chance of igniting the blowout. As a result the oil came out as an emulsion.

Cleanup operations concentrated on keeping the oil from impacting the beaches by dispersing it at sea. *Dispersant applications* began on August 9, and were supervised by Texaco Trinidad, Inc. Application was done by airplane, and continued until August 14.

Approximately 3,200 gallons of dispersant were used. Most of the dispersant applied was *Petrolite W923*; however, *Basol AD6*, *Amoco Wellaid 311*, and *Shell Dispersant L.T.* were also used. The Petrolite W923 proved to be the most effective, while Basol AD6 was the least effective. Dispersant applied in greater concentrations worked the best on the slicks.

References:

- Genwest Systems, Inc. communications with ITOPF representatives.
- IFP. PLATFORM DATABANK on Accidents to Drilling Vessels or Offshore Platforms (1955-1989).

Name of Spill: UMTB 283
Date of Spill (mmddyy): 12/26/88
Location of Spill: Aleutian Islands, Alaska
Latitude: 54 46 N
Longitude: 158 18 W
Oil Product: Diesel
Oil Type: Type 2
Barrels: 47,620
Source of Spill: Barge
Resources at Risk: Shorebirds, bird wintering areas, anadromous fish, spawning streams.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Adverse weather conditions.
Shoreline Types Impacted: None
Keywords: Adverse weather conditions, remotely operated vehicle (ROV), sinking, remote response, evaporation.

Incident Summary:

On December 26, 1988, the United Marine Tug and Barge, Inc. (UMTB) Tank Barge 283, towed by the tug *Marine Explorer*, began sinking stern down approximately 35 miles southeast of Simeonof Island, on the western side of the Gulf of Alaska. The tug and barge, en route to Dutch Harbor with approximately 47,620 barrels of diesel on board, encountered extremely rough weather. The pump room and starboard aft tanks, which had been empty, were now flooded, causing the barge to turn bow-up with approximately 80 feet of the barge above water and the remaining 200 feet below the surface. The tug's crew members observed oil coming from the vicinity of the waste oil tanks in the stern area. Although the barge owner speculated that the stern anchor had punctured the aft waste oil tank, the exact cause of the sinking was never determined. The salvage vessel *M/V Salvage Chief* hired by Seattle-based UMTB arrived on January 7 after an eight-day passage from Astoria, Oregon. Meanwhile, the barge continued leaking diesel fuel as 50-60 knot winds and 20-25 foot seas pounded the area.

By January 4, only 40 feet of the barge's bow remained above the surface. From the attitude of the barge, the owner's naval architects and salvage master speculated that four tanks remained filled with diesel fuel while the other tank's cargo was displaced by water.

Initially, the owner requested resource agency clearance to move the barge to Stepovak Bay for lightering and repair operations. As the barge, with the tug and tow line still attached, drifted northeast parallel to the coast, evaluations of Stepovak, Castle, Devil's, and Kuiukta bays, along the southeastern side of the Alaska Peninsula, were requested of NOAA. The upright-floating barge was extremely difficult to tow. The vessels were caught in a clockwise back-eddy off of the southwesterly flowing Alaska stream which carried them towards the northeast.

The weather remained severe (Beaufort Force 9 with icy conditions) throughout the entire incident. Even though the tug *Marine Explorer* remained attached to the barge, it was virtually impossible for it to influence their naturally drifting motion and trajectory. On January 11, 1989, the owners requested USCG assistance in sinking the barge. On January 13, the USCG Cutter *Sedge* used 1500 rounds of 20 mm fire to sink *Barge 283* in approximately 102 fathoms of water. The case was closed on January 18, 1989.

Behavior of Oil:

Even though divers from the *Salvage Chief* were able to plug some of the barge leaks, an estimated 23,810 barrels of diesel was lost before the barge was sunk.

A representative from the Alaska State Department of Environmental Conservation (ADEC) estimated that up to 95 per cent of the diesel oil evaporated as it was agitated by seas of up to 18 feet.

On December 29, USCG observers noted a very light sheen around the barge which was still notable on January 9. Overflights after the sinking on January 13 revealed only a minor oil sheen of approximately 1 mile by 0.5 miles near the sinking.

Countermeasures and Mitigation:

The tug *Salvage Chief* arrived on-scene January 7 with divers and a *remotely operated vehicle (ROV)* to investigate the bottom of the barge. Small cracks found in the port and starboard main decks were sealed with *wooden plugs*.

After considering all the options, UMTB asked the USCG for assistance in *sinking* the barge. The barge was sunk by the USCG Cutter *Sedge* at 1246 on January 13, 1989, approximately 11 miles southwest of the Semidi Islands at 55 48 N and 156 46 W.

Due to the location of the spill, on-scene weather conditions, and the rate of oil leakage, *no cleanup action* was performed.

Other Special Interest Issues:

Adverse weather conditions prevailed throughout the response. UMTB had to ask the USCG for assistance in the scuttling of *Barge 283* because the weather prevented them from dealing with it themselves. The *M/V Salvage Chief* arrived on-scene several days later than scheduled due to rough seas and gale-force winds.

References:

- Oil Spill Intelligence Report. International Spill Statistics 1989-1990, Special Report, 3/28/91
- Oil Spill Intelligence Report. Newsletter 2/21/91
- Oil Spill Intelligence Report. Oil Spills, International Summary & Review, 1989-1990
- U.S. Coast Guard POLREP file.

Name of Spill: *Urquiola*

Date of Spill (mmddyy): 05/12/76

Location of Spill: La Coruña, Spain

Latitude: 43 22 N

Longitude: 008 23 W

Oil Product: Light Arabian crude oil, Bunker fuel

Oil Type: Type 3, Type 4

Barrels: 733,000

Source of Spill: Tank Vessel

Resources at Risk: Recreational beaches, marinas, waterfowl, gulls, wading birds, commercial fisheries, power plant water intakes, sand/gravel beaches, exposed rocky shores, marshes, tidal mudflats, clams, oysters, mussels.

Dispersants: Yes

Bioremediation: No

In-situ Burning: Yes

Other Special Interest: Adverse weather conditions, closure of commercial fishing areas, effects to tourism, habitat impact due to oil, habitat impact due to cleanup operations, logistical or operational problems, research conducted.

Shoreline Types Impacted: Sand/gravel beaches, exposed rocky shores, marshes, tidal mudflats.

Keywords: Adverse weather conditions, skimmer, boom, fire, explosion, manual removal, contingency plan, sawdust, reoiling, vacuum truck, lightering.

Incident Summary:

On May 12, 1976, the Tank Vessel *Urquiola* struck a submerged object while approaching the Coruña Oil Terminal at La Coruña, Spain. The vessel began to leak cargo from the damaged bow section. Due to the threat of explosion and fire, the Port Commandant ordered the *Urquiola* out of the harbor, away from the refinery and town of 200,000 inhabitants. While being assisted out of the harbor by two tugs, the leaking vessel grounded again, further rupturing the bow tanks. All of the crew, except for the captain and pilot, abandoned the ship when it began to list.

Two hours later the vessel exploded, killing the captain. Approximately 513,000 barrels of oil burned in the subsequent 16-hour fire. Burning oil spread out from the vessel and was eventually extinguished by the cooling effect of the seawater. Dense clouds of smoke were blown over the town of La Coruña. A safety zone one mile in radius was established around the vessel after air monitors detected high levels of volatile gases. Despite these precautions, a second explosion and fire rocked the vessel on the morning of May 14.

Between May 12 and May 21, oil was estimated to be leaking at a rate of 2,200 barrels per day. An estimated 180,000-220,000 barrels of the cargo polluted the Spanish coast. On May 21, a smaller tanker and tug began lightering the *Urquiola*. About 50,000 barrels of crude oil had been removed from the vessel by May 25, when lightering operations were halted by rough seas. Ten- to fifteen-foot seas detached a large section of the bow. On June 8, the stern

section, containing an estimated 22,000 barrels of bunker fuel, was towed to a more protected area five miles to the west. The stern was partially lightered before developing a crack in one of the tanks that resulted in further, limited leakage.

Following the fire, the Spanish Navy and a fleet of commercial vessels *applied over 2,000 tons of chemical dispersants* to the *Urquiola* and surrounding waters in spite of resistance mounted by Spanish oceanographers. Cleanup of the oiled shoreline was primarily accomplished by manual labor. Skimmers and booms were used for water recovery with mixed results.

Behavior of Oil:

Arabian Light crude oil is a medium weight product with an API gravity of 33.4 and a pour point of -30 degrees F. Bunker fuel oil is a heavy product with an API gravity that ranges from 7 to 14. Prevailing northwest winds blew the oil onshore. *The smoke from the fires rained oil droplets on the city of La Coruña.* Oil escaping from the vessel was spread toward shore by a weak northerly coastal current and onshore winds. The heaviest oiling occurred within the bays closest to the grounding site. The three bays, or *rias*, that experienced the most oiling were Rias de La Coruña, Rias Area, and Rias Betanzos. Some oil coverage in excess of 65 per cent was reported along the shoreline areas of these bays. Beaches at Raso and Perbes were severely oiled. Even though oil quickly entered these bays, it took nearly a week before the marshes and tidal flats at the heads of the bays were oiled. These marshes and tide flats may have been protected if boom had been deployed during the previous week. Along the outer coast, moderate oiling was observed as far north as Playa de Doninos, approximately 10 miles from the grounding site. By May 19, oil had come ashore further to the north, near Frouxeria and Pantin. Large slicks of oil were spotted offshore of Ria de Cedeira, but no shoreline oiling occurred in this area.

Oiling was observed to the southwest near Barranan on May 21. Strong northeast winds on May 25 and 26 resulted in further westward movement of the slicks. On May 31, westward contamination stretched to Playa de Beo, 28 miles from the grounding. Beach areas between La Coruña and Playa de Beo were lightly oiled, mainly in the form of oil swashlines. By June 1, nearly 215 kilometers of the northwestern Spanish coast was oiled. Moderate (25-65 percent coverage) and heavy (greater than 65 percent coverage) oiling occurred on 37 miles of shoreline.

Much of the floating oil became emulsified and mixed with seaweed and debris, making recovery difficult. *Some emulsions were up to a half-meter thick.* Many of the recreational beaches were heavily oiled. *Oil penetrated several feet deep in the intertidal zone of some exposed beaches.* The chemical dispersant application was believed to have dissipated several thousand barrels of the light crude oil into the 18°C water of the inner bays.

Countermeasures and Mitigation:

The largest mobilization of resources occurred during the dispersant application. As many as eleven vessels were involved in applying the hydrocarbon based chemical products. Many different products were reportedly used during the operations, including *BP 1100X*, *BP 1100WD*, *Finasol*, *OSR2*, *Shell Dispersant LT*, *Solufax 85*, *Seaklin 1100NT*, *Kraken MC563*, *CEPSA 3 Marine Dispersant*, and *Marlu*. However, some observers believed that *all the dispersant applied was of Spanish origin. Several hundred empty dispersant drums labeled with old product names were seen being filled from tank trucks.*

Some attempts were made to contain floating oil with boom. Due to the lack of an oil spill response or contingency plan, booming equipment was not available locally. A 36-inch French-made boom was borrowed from a nearby refinery, but sank after three days of use. *American Marine Optimax* and *18-inch Uniroyal boom* were flown in from Great Britain. These two booms managed to contain oil but broke loose because of wind and sea conditions.

Komara *skimmers* were used to recover floating oil at various locations. One skimmer was staged near a power plant intake to prevent the oiling of the water intake. Very little oil appeared near the plant, and the skimmer was put on standby. The Komara skimmer was tested at Conabal Bay and Mera Bay. At these locations the emulsified oil was up to half a meter thick. *Recovery rates in these conditions were about 15 barrels per hour.* The Petroliba oil refinery provided a Vikoma skimmer that had recently been delivered. The Vikoma skimmer immediately clogged with debris and was damaged. After being repaired with parts shipped from Great Britain, the skimmer failed to pick up the thick emulsions of oil that were collected in booms. *A large British Petroleum Seaskimmer was also quickly clogged by oiled debris and thick weathered oil.* The use of both the Vikoma and Seaskimmer equipment was discontinued.

Skimming equipment was also flown in to aid the cleanup effort. Oil Mop (UK) Ltd. negotiated a 30 day contract to conduct oil recovery. Oil Mop personnel claimed they would recover 733-1100 barrels per day, but were only able to recover an average of about 220 barrels per day. *The Oil Mop scavenger unit did, however, compare favorably to the recovery rates of the other skimmers and was also able to follow and recover oil in areas otherwise inaccessible from shore.*

Cleanup of the oiled beaches was a slow and methodical process. Many of the affected areas were unsuitable for the use of mechanical cleanup equipment. The decision was made by local authorities to spend available money to employ the local people rather than purchase complex equipment. Cleanup operations were very slow where oiling was extremely heavy. Much of the cleanup was conducted simply by using *buckets and shovels*. A 12-foot tidal range contributed to the difficult task of removing heavy concentrations of oil. In some areas, cleanup techniques were improperly applied. *The application of sawdust as an absorbent proved ineffective in areas with heavy*

oil accumulation. *A front-end loader and grader were later used unsuccessfully to aid the cleanup of beaches. Repeated working of the beach with heavy equipment forced oil deeper into the sediments. Removal of large quantities of sand threatened to destabilize the beaches.* This threat was augmented by additional cleaning required by reoiling

The *most successful cleanup* operation involved the *combination of machinery and manual removal*. Trenches were dug above the high tide line with mechanical equipment. Laborers swept or hosed floating oil into the trenches where it was recovered by vacuum trucks.

Beaches were initially hosed with chemical dispersants. This was soon abandoned due to a lack of pumps. *Oil penetration into the sediments at La Coruña may have resulted from this initial washing of the beach with dispersants.*

Other Special Interest Issues:

The shellfish stocks of the La Coruña area are among the most important in Spain. The spill's effect on the local shellfish fisheries was noticed almost immediately. By May 17, nearly 20 percent of the *cockle* (*Cerastoderma edule*) population in the Rio de Burgo area was dead. Many of the survivors were moribund and thought likely to die. *Mortality in some areas was as high as 70 percent.* There was concern about the reproduction of these stocks, and recovery rates were expected to be slow. Slow growth rates of clams, oysters, and mussels suggested that recovery for these organisms would also be a very slow process.

Observed effects to bird populations were minimal. Except for gulls, very few seabirds or shorebirds were seen in the area. A few oiled wading birds were spotted, but the only observed bird mortality was a duck.

The inshore fisheries of the area, which include sardines and hake, were shut down. The fishermen chose not to fish due to fears of oiled nets, tainted fish, and depleted stocks. However, the offshore fisheries remained open during the duration of the spill, and unusually large catches of certain species were made the following year.

References:

- 1991 World Almanac
- 8/9/91 & 8/28/91 Letters from Daniel Owen at ITOPF
- Genwest Systems, Inc. communications with ITOPF representatives.
- Gundlach, E.R. and Hayes, M.O. 1977. The Urquiola Oil Spill, La Coruña, Spain: Case History and Discussion of Methods of Control and Clean-up. Marine Pollution Bulletin. v.8, n.6. pp. 132-136.
- Gundlach, et al. 1978. Some Guidelines for Oil-Spill Control in Coastal Environments, Based on Field Studies of Four Oil Spills. Chemical Dispersants for the Control of Oil Spills, ASTM STP 659. L.T. McCarthy, Jr., G.P. Lindblom, and H.F. Walter, Eds. American Society for Testing and Materials. pp. 98-118.
- Hooke, N. Modern Shipping Disasters 1963-1987. Lloyds of London Press. 1987.
- MMS Worldwide Tanker Spill Database
- Robertson, et al. 1976. The Urquiola Spill, La Coruña, Spain. Environment Canada. Spill Technology Newsletter. v.1. pp. 54-57.
- Tanker Advisory Center, Inc. 1991 Guide for the Selection of Tankers. T.A.C. Inc. 1991.

Name of Spill: U.S. Strategic Petroleum Reserve
Date of Spill (mmddyy): 09/21/78
Location of Spill: West Hackberry, Louisiana
Latitude: 29 59 N
Longitude: 093 22 W
Oil Product: Arabian Light crude oil
Oil Type: Type 3
Barrels: 72,000
Source of Spill: Facility
Resources at Risk: Waterfowl, fish nursery areas, crabs, shrimp, crustacean nursery areas.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Research conducted
Shoreline Types Impacted: Freshwater marshes
Keywords: U.S. Strategic Petroleum Reserve, blowout, fire, boom, skimmer, vacuum truck, Regional Response Team, contingency plan.

Incident Summary:

The U.S. Strategic Petroleum Reserve is a one-billion barrel store of imported crude oil. The Hackberry facility is one of three active storage sites in the U.S. The sites consist of caverns that are leached out of subterranean salt domes and are filled with oil by barges, tankers, and pipelines. The oil contained in these domes is injected under pressure and, if any of the domes are vented, they will discharge until depressurized.

At 1600 on September 21, a major oil spill and fire occurred at the U.S. Strategic Petroleum Reserve (SPR) in West Hackberry, Louisiana. At the time of the accident, *the storage facility at Hackberry contained roughly 14.2 million barrels of crude oil.* During the removal of a well string for maintenance, the plug used to cap the well was released, sending drilling mud and crude oil out the top of the string. *The low-flash point crude oil was ignited by nearby diesel engines* and the resulting fire burned for five days. The release of 72,000 barrels of oil was initially contained within a containment dike. A breach of the dike the next day spilled 32,000 barrels of the oil into nearby Black Lake.

Containment of the spill in the lake was accomplished by redundant tiers of boom. After the fire was extinguished, skimmers were used to recover the contained oil. Consistent winds and good weather greatly aided the recovery efforts. Coast Guard personnel were involved in deploying boom and other recovery operations. Cleanup operations were concluded on October 11, following an on-site inspection by the Regional Response Team (RRT).

Behavior of Oil:

Arabian Light crude oil is a medium-weight product with an API gravity of 33.4 and a pour point of -30 degrees F. Oil fumes escaping from the drill string were drawn into the intakes of nearby diesel motors and ignited. The fire burned for five days and resulted in one fatality. Airborne smoke and oil were blown downwind to the southwest, hampering oil spill response. Most of the 72,000 barrels of oil that escaped from the well was initially contained within the dike that surrounded the facility. The dike gave way the following morning, dumping 32,000 barrels of oil into Black Lake, which serves as an important nursery area for fish, crabs, and shrimp. The dike, which was not designed to retain a spill of this magnitude, was found to be structurally deficient before the blowout, but had not yet been repaired.

Countermeasures and Mitigation:

Countermeasures involved the control of the fire and well blowout, as well as the containment and recovery of the spilled oil. Recovery of the oil was delayed until fire fighters extinguished the blaze at the western end of the site with foam. A number of pits were dug into the shoreline at the western edge of the site. These pits temporarily stored the oil recovered by skimmers and pumps. Oil in the pits was picked up by vacuum trucks and hauled to nearby storage tanks and barges.

Seven skimmers operated on the lake at the peak of the cleanup. *Three "paddle wheel" type skimmers and four Oil Mop Rope Skimmers recovered as much as 8 barrels of oil per hour* until skimming operations were terminated on October 2.

The floating oil was contained by boom that was deployed at the western end of the facility. Three tiers of boom were eventually used to contain the oil. The inner most boom was breached in areas where segments of different types of boom were joined. All of the oil that entered the lake was contained within booms near the facility. Oil that collected in the booms was up to 5 inches deep. More than 32,000 barrels of oil were reported recovered from the lake. Another 20,000 barrels of oil trapped on the facility grounds was returned to storage. Some onshore accumulations of oil were as deep as 18 inches.

Winds remained from the northeast and helped to hold the floating oil against the shoreline and within the booms. Had the winds shifted, however, the immense quantity of oil would have made containment difficult. Backup plans were made in the event of adverse weather or a shift in the winds. Additional equipment was deployed in the lake. A *DIP 3001 skimmer* was stationed in the lake, north of the third barrier of boom. A second DIP 3001 skimmer was brought on-scene from the Brian Mound (SPR) and launched nearby as a backup. Two 8,000-barrel barges were stationed in the area to receive recovered oil from the skimmers. A total of three tiers of containment boom were deployed to contain the floating oil.

After the recovered oil was analyzed for contamination, the bulk of it was reinjected back into the storage caverns. *More than 72 percent of the 72,000 barrels of oil that escaped was eventually returned to the reserve.* An estimated 20,000 barrels of oil were either burned in the fire or deemed unrecoverable. Long-term protection of the lake against residual oiling was mitigated by deployment of an 1,800-foot section of heavy-duty boom surrounding the well pad. The RRT inspected the site on September 26 and approved the termination of cleanup operations on October 11.

Other Special Interest Issues:

The Department of Energy retained overall control of the cleanup operation and assigned an On-Scene Coordinator (OSC). Coast Guard personnel, operating under the OSC, managed the cleanup contractors and provided field experience and oil spill expertise.

Cleanup of the lake was termed "*a classic in oil containment from a major spill*" in testimony at the hearings that followed accident. Although a final contingency plan was not in place at the time of the accident, personnel from the facility were involved in a contingency planning seminar the day before the spill. The DIP 3001 skimmer had been made active the week before the accident and was tied up at a nearby dock.

Research activities following the incident included attempts to identify both oil and airborne combustion products from the spill over the year following the incident. Results of this study concluded that oil contamination from the Hackberry site was confined to a small area of Black Lake. The extent of contamination was measured, and fluoranthene and pyrene levels due to combustion products from the fire were monitored in foliage, soil, and sediments in adjacent areas.

References:

- OSIR Oil Spills, International Summary & Review, 1978-1981
- Overton, et al. 1981. Identification of Petroleum Residue Sources After a Fire and Oil Spill, Oil Spill Conference Proceedings, 1981, pp. 541-546.
- U.S. DOE. 1978. Report on the Explosion, Fire, and Oil Spill Resulting in One Fatality and Injury on September 21, 1978, at Well 6 of Cavern 6 at the West Hackberry, Louisiana, Oil Storage Site of the Strategic Petroleum Reserve.
- Wilson, J.E. and Gallagher, J. 1979. Cleanup of a 32,000-Barrel Crude Oil Spill at the West Hackberry Dome Storage Site in Louisiana, Oil Spill Conference Proceedings, 1979, pp. 437-440.

Name of Spill: Virgin Islands Water and Power Authority
Date of Spill (mmddyy): 09/18/89
Location of Spill: Christiansted, St. Croix, U.S. Virgin Islands
Latitude: 17 45N
Longitude: 064 40W
Oil Product: No. 6 Fuel Oil
Oil Type: Type 4
Barrels: 14,070
Source of Spill: Facility
Resources at Risk: Coral reefs, diving coastal birds, Pelicans, sea turtle nesting beaches, water intake.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Human health and safety concerns.
Shoreline Types Impacted: Fine sand beaches, mangroves, exposed rocky shores.
Keywords: Atlantic Strike Team (AST), boom, vacuum truck, hydro-blasting, manual removal, sorbent boom.

Incident Summary:

On September 18, 1989, *Hurricane Hugo* hit the island of St. Croix with winds in excess of 140 miles per hour, damaging the steel containment walls around two of the main *No. 6 fuel oil storage tanks* at the Virgin Islands Water and Power Authority (VIWAPA) power plant in Christiansted Harbor on the north coast of St. Croix. Oil leaked from a severed discharge line near the bottom of one or both of these 54,000-barrel capacity tanks. It then overflowed the containment dike and moved toward the beach 250 feet away. VIWAPA personnel constructed sand-based containment trenches and berms along the beach to contain the oil. They also diverted oil to a diesel storage tank containment area. Oil began to leak through the trenches, proceeding down the sloping base toward the shoreline. U.S. Coast Guard (USCG) Marine Safety Office (MSO) San Juan personnel flew over the area on September 21 and estimated that approximately 48 barrels of oil had overflowed the trench and entered the harbor, impacting the sand beaches west of the facility.

MSO and USCG Atlantic Area Strike Team (AST) personnel arrived on-scene on September 22. They immediately began working with VIWAPA and contractor personnel to locate and stop the leak. The Strike Team lowered the level of oil in the containment areas and secured the leak on September 25. The containment wall had been blown by the wind onto a ten-inch transfer pipe, rupturing the pipe. An open valve had permitted the oil to escape through the broken pipe. A total of 14,076 barrels escaped from this tank between September 18 and 25. Approximately 1,000 barrels overflowed the containment area and entered the water. Three miles of sand beaches were heavily oiled, with some impacts east of the power plant in the harbor area. Some of the oil refloated, but local meteorological and oceanographic conditions isolated the resultant secondary impacts to previously oiled

beaches. Response efforts concentrated on the recovery and removal of the oil after it was on the beaches. No dead fish or animals were reported.

Behavior of Oil:

No. 6 fuel oil is a heavy product with an API gravity that ranges from 7 to 14. The trenches helped contain the oil initially, but by September 21, approximately 1,000 barrels of oil had overflowed the trench and impacted the tourist beaches west of VIWAPA, leaving a band 10 feet wide and three miles long on the beach. The oil was driven into the sandy beaches by strong easterly winds and longshore currents. Oil continued to spread along the coastline towards a mangrove area in and around Salt River Bay.

The shoreline to the east was less heavily oiled, extending one mile to the downtown Christiansted waterfront area. None of the oil made it west to White Horse or into Altoona Lagoon. However, sand beaches were oiled as deep as two feet in some places. Tarballs continued to appear near Cathy's Fancy up to four months after the incident.

Countermeasures and Mitigation:

Booms were used extensively in the response effort. One thousand feet of two-foot high boom was used to hold oil along the concrete pier west of VIWAPA. *Absorbent booms* were deployed in the surf line for two miles west of VIWAPA. The winds and currents were used to an advantage in the deployment of absorbent boom. *Expandiboom* was used at several points to the west to deflect the moving oil onto the beaches where it could be recovered. Two thousand feet of two-foot boom was placed to the east of VIWAPA, towards downtown. Two hundred feet of two-foot boom protected a Kings Wharf desalination plant intake from the oil. The primary containment area started by VIWAPA personnel was reinforced with additional outboard boom. In total, five thousand feet of boom was deployed in the area surrounding VIWAPA.

Oil was *pumped* from the base of the leaking tank to a Hess Oil Virgin Islands Corporation (HOVIC) *tank barge* using a repaired discharge pipeline on September 25. Pumping at a rate of 1000 barrels per hour, the oil containment level lowered three feet in three hours. With the lower level, the Atlantic Strike Team was able to locate and secure the source of the leak.

Vacuum trucks were used to remove the oil in the earthen trenches and waterborne booms. Oil went from the vacuum trucks to the No. 6 tank containment pit where it was pumped into the HOVIC barge via the repaired discharge pipe. The diesel tank containment was emptied by September 30 by the Strike Team while contractors continued pumping the No. 6 containment pit. HOVIC took this oil to their facility on the south side of St. Croix for recovery.

Four hundred people were hired for manual beach cleanup. The gently sloping beaches consisted of mostly fine-grained sand. *Front-end loaders*

skimmed contaminated layers of sand from long stretches of beach. As the response and cleanup progressed, 30,000 cubic yards of sand was removed from three miles of beach. The *Virgin Islands Department of Planning and Natural Resources (DPNR)* became concerned that too much sand was being removed from the beaches. High tide caused re-oiling to continue for several weeks. USCG, DPNR, and VIWAPA agreed to try to reduce the amount of sand being scraped off the beaches. [Since the spill, natural longshore transport of sand has restored the majority of the beaches.] Rocky areas and waterfront piers received *hydro-blasting treatment*. The oily runoff was then caught in booms. Beaches were considered "oil-free" after 60 straight days of manual cleaning. Four creek areas required extensive use of *sorbent materials* beyond the initial 60 days.

On October 3, the Coast Guard MSO requested that the National Oceanic and Atmospheric Administration (NOAA) Scientific Support Coordinator (SSC) travel to St. Croix to advise DPNR on the oiled sand disposition and beach replenishment. After observing the cleanup operations and meeting with DPNR, USCG, and VIWAPA cleanup contractor personnel, the SSC recommended that very heavily oiled sand be removed from the island, for disposal in an approved landfill, and a *landfarming* technique be used to bioremediate the remaining sand. Landfarming would allow the *natural biodegradation* of the oil in the sand to progress at a faster rate than if left on the beach or in mounds. By spreading it out and turning it over periodically, the oil level in the sand would eventually be low enough to return it to the beaches. This would drastically reduce the amount of sand hauled off the island, thus needing to be replaced.

Two other options considered were *sand washing* with solvents in a soil-cleaning apparatus, and complete off-island disposal with replacement using similar sand from an off-island source. The landfarming option was preferred over the sand washing because of expense, the lack of a precedent in a Caribbean area, and the introduction of another pollutant (solvent) into the system. The removal/replacement option was prohibitively expensive. Also, land farming is currently an approved method of oily sludge treatment at the Hess Oil Refinery on St. Croix.

Other Special Interest Issues:

Due to the destruction from Hurricane Hugo, all agencies were lacking vital communication facilities. Therefore, mobile satellite communications were critical to the success of the response. Other parts of the island's infrastructure, such as potable water, electricity, and sanitation facilities, were also destroyed by the hurricane and hampered response efforts.

Response personnel experienced physical security threats from armed groups of escaped convicts in remote beach areas. Beach monitors often encountered armed individuals on these remote beaches. Also, civilians were armed to protect their property from crowds of looters. Personnel at the VIWAPA command post regularly heard gunfire in the evenings.

Political pressure to emphasize activities of beach cleanup crews may have interfered with the primary goals of securing the discharge and containing and recovering all floating oil. The desire to focus on more visible cleanup such as beach crews appeared to affect the cleanup efforts.

References:

- Bills, C.E. and Whiting, D.C. 1991. Major Oil Spills Caused by Hurricane Hugo, St. Croix, U.S. Virgin Islands, Oil Spill Conference Proceedings, 1991, pp. 247-251.
- NOAA Response Report
- Oil Spill Intelligence Report International Spill Statistics 1989-1990, Special Report, 3/28/91
- Oil Spill Intelligence Report Oil Spills, International Summary & Review, 1989-1990
- USCG On-Scene Coordinator's Report

Name of Spill: V882, V883, V884, V885
Date of Spill (mmddyy): 04/02/83
Location of Spill: Mile 179.0 Upper Mississippi River, St. Louis, Missouri
Latitude: 38 40 N
Longitude: 090 15 W
Oil Product: Montana Mix sour crude oil
Oil Type: Type 2
Barrels: 13,212
Source of Spill: Tank Barge
Resources at Risk: Vegetated riverbanks, low banks, developed uplands.
Dispersants: No
Bioremediation: No
In-situ Burning: Yes
Other Special Interest: Adverse weather conditions
Shoreline Types Impacted: Vegetated riverbanks, low banks, developed uplands.
Keywords: Adverse weather conditions, Gulf Strike Team (GST), deflection booms, vacuum truck, sorbents, airboats, manual removal, oil snares, fire, explosion, reoiling.

Incident Summary:

At approximately 2315 on April 2, 1983, the *M/V City of Greenville* with a tow of four tank barges struck the Illinois pier of the Poplar Street Bridge near downtown St. Louis, Missouri, on the Mississippi River. Weather at the time was cloudy and overcast with light rain. Visibility was 8 miles with winds gusting from the northwest to 25 miles per hour. Crew error was the primary cause of the accident. The barges, V882, V883, V884, and V885, were laden with a total of approximately 65,003 barrels of Montana Mix sour crude oil. One of the barges exploded on impact and burst into flames. As the fire continued to spread, the tow broke, setting three of the burning barges adrift down the river. The tug and attached barge V885 were moved to the Peabody Coal facility at mile 179.2 for lightering and inspection.

The three drifting barges caused extensive damage to facilities and other barges along the left descending bank on the Illinois side of the river. While traveling downriver, one of the barges struck the Pillsbury Grain dock facility. The fire spread to the dock, the grain elevator, and trees and bushes on the shoreline. Three grain barges nearby caught fire as well. A coal barge on the Missouri side of the river ignited from contact with one of the barges. The Monsanto dock caught fire after being struck by one of the barges, and the impact ruptured a pipeline on a walkway, *releasing approximately 100 pounds of monochlorobenzene into the river.*

Barge V884 suffered the most damage, both the barge and its discharged cargo on the river's surface were in flames. After drifting downstream, V884 sank at mile 178.2 Upper Mississippi River (UMR) near the Cahokia Power Plant. The barge continued to release its total cargo of 10,882 barrels of crude oil. While burning out of control, barge V883 lodged bow first into the bank above the Cahokia Power Plant. The fire spread uncontrollably onto the

shore. An hour later, V883 broke loose and continued drifting down the river, still engulfed in flames. The M/V *Katie* eventually grounded V883 by pushing it into the bank at the Pillsbury Facility. The leading barge, V882, was forced into the Arsenal Island barge fleet area after being controlled by the M/V *Gary D. Partridge*.

The USCG Cutters *Obion* and *Cheyenne* fought the fire on V883 as well as the fire at the Phillips facility. The cutters used all but two of their fire fighting foam cans. To reduce the probability of reflash, the *Cheyenne* applied a low-velocity water fog to V883. The M/V *Tom McConnel* used her propwash to keep burning oil on the water from reaching the *Cheyenne* during firefighting operations. By 1330 on April 3, the fires on the three escaped barges, the three grain barges, and the Pillsbury dock were out.

Valley Towing Service, Inc., the owners of the tug and barges, assumed financial responsibility for the cleanup. Three pollution cleanup sites were established at mile 177.6, 176.6, and 176.2 UMR. A joint Regional Response Team (RRT) Region V and VII meeting was held in St. Louis on April 5, 1983.

Behavior of Oil:

Each barge leaked at least some of its cargo as it drifted down the river. After it sank, a heavy stream of black oil flowed from V884 down the Illinois side of the river and into the lowlands. Personnel on an April 4 overflight observed heavy patches of oil from mile 179.0 to mile 160.0 in the Upper Mississippi River and heavy ribbons of oil were observed below mile 160.0. Sheen was sighted all the way to St. Genevieve, Missouri.

On April 5, discharge from V884 stopped, but there was still a great deal of oil in the river. Oil coverage on the river between miles 179 and 168 was substantially reduced by April 6 due to the swift currents. Sheen covered 5 to 10 percent of the river between miles 155.1 and 168 UMR. Heavy concentrations were spotted at mile 155 UMR on the Missouri side.

Due to the continued rise and fall of the river from day to day, the remaining oil in the Mobil East site was stranded on the shore by April 26. Heavy rains and rising water a few days later spread some of collected oiled debris out again. Cleanup operations, which ended on May 9, cost approximately \$550,000. An estimated 41,871 gallons of spilled oil and 4,201 cubic yards of oily debris were collected during cleanup operations.

Countermeasures and Mitigation:

APEX Towing Company lightered barge V885. The barge was then moved to the National Marine Service gas-free plant in Woodriver, Illinois, for survey and repair. After barge V882 had been moved to the Arsenal Island barge fleet area by the tug M/V *Gary D. Partridge*, MSO and GST personnel plugged the vents on it to stop any further oil leakage.

Oil was collected at the three sites along the Illinois shore with the use of *deflection booms* and *vacuum trucks*. About 100 feet of deflection boom was deployed between a buoy and a tree on the bank near the Arsenal Island shoreline. This boom contained escaping oil from the fleeted barges upstream.

Sorbents were used at Lock and Dam 27 to collect and recover oil. A *crane barge* removed an oil soaked log jam at the Cargill Salt dock.

Oil herding techniques varied due to the constantly changing winds. Jon boats and wash pumps were successful to an extent. *Airboats* were the most effective tool for herding the oil, although they require open spaces to work in so that they don't catch anything in their props.

Heavy equipment and *manual labor* was necessary to clean up the saturated lowlands of Arsenal Island. Collected debris was piled up for *drying* and was then *burned*. Heavy rains in late April often extinguished the burn piles. Landlocked oil at the Mobil East site required manual removal and *garden tractors*.

Barge V884 salvage operations took place from August 22 to October 21. *Oil snares* were deployed around the equipment to collect any escaping oil. Only minor ribbons of quickly dissipating oil were released when the barge was raised.

Other Special Interest Issues:

Wind changes, high water, and swift currents were a continuous problem throughout the response. Wind changes were unpredictable, requiring constant changes in the cleanup plan. Weather during the response ranged from sunny and warm to snow, and was harsh most of the time, requiring the use of personal protective clothing for all weather conditions. Cleanup was slowed because the unusually high waters had deposited oil in trees and heavy underbrush.

References:

- USCG On-Scene Coordinator's Report

Name of Spill: *Venoil*

Date of Spill (mmddyy): 12/16/77

Location of Spill: Cape St. Francis, South Africa

Latitude: 34 26 S

Longitude: 024 04 E

Oil Product: Iranian heavy crude oil, Bunker fuel oil

Oil Type: Type 3, Type 4

Barrels: 219,000

Source of Spill: Tank Vessel

Resources at Risk: Recreational beaches, National Park, bivalve aquaculture site, oysters, lagoons, fringing wetlands, tidal mudflats, salt marshes, commercial fisheries, seabirds, seabird breeding colonies, seals, dolphins, whales, crabs, shrimp, Nature Reserve.

Dispersants: Yes

Bioremediation: No

In-situ Burning: No

Other Special Interest: Effects to recreation areas, unusual or experimental cleanup techniques, wildlife impacts.

Shoreline Types Impacted: Fringing wetlands, tidal mudflats, salt marshes, coral reefs.

Keywords: Manual removal, straw, suction operations, sub-surface oil, collision, fire, International Tanker Owners Pollution Federation (ITOPF).

Incident Summary:

On the morning of December 16, 1977, the *Venoil* and the *Venpet* collided 40 miles off Cape St. Francis, South Africa. The *Venpet* was damaged, releasing burning bunker oil over the starboard deck of the *Venoil* and into the surrounding water. The *Venoil* suffered serious fire damage. The impact also holed two of the *Venoil's* tanks. Both ships were abandoned, and began to drift towards the coast. The fires on board both vessels went out as they drifted.

Behavior of Oil:

Iranian Heavy crude oil has an API gravity of 31.0, and a pour point of -5 degrees F. Bunker fuel oil is a heavy product with an API gravity that ranges from 7 to 14. Approximately 155,000 barrels of Iranian heavy crude oil, and 33,000 barrels of bunker fuel oil spilled from the *Venoil*. Approximately 31,000 barrels of bunker fuel oil spilled from the *Venpet*, in ballast at the time of the collision. *Of the 219,000 barrels of oil spilled, it is estimated that 25 percent burned.*

Overflights on December 17 revealed a slick of emulsified oil 25 miles from the coast and moving west. The slick moved towards the coast for a week. By December 24, the oil was in the Plettenberg Bay area, four miles from the coast of the Tsitsikama Nature Reserve. A day later the oil moved away from the coast in a WSW direction. A previously undiscovered slick was found in the area between Plettenberg Bay and Mossel Bay on December 25. The slick consisted of patches of emulsified oil in a 100-square mile area. The slick

moved in a westerly direction. On December 28, the oil came ashore and, over the next four days, 80 miles of shoreline were impacted. Most of the area received light oiling, with the area between the Little Brak and Great Brak rivers receiving some heavy concentrations of oil. Oil impacted the river banks, mudflats, sandflats, marshes, and a reef in that area. Oil also sank in the river and nearby lagoons as sand became incorporated into the mousse and salinity levels dropped. Oil reached two miles up the Little Brak River.

Overflights on January 3 revealed that there was no oil in the water in the area 45 miles from the shore between Cape Agulhas and Port Elizabeth.

Countermeasures and Mitigation:

Both vessels were taken under tow to prevent their grounding near the coast. By December 18, the *Venoil* was 30 miles from the coast, and the *Venpet* was 47 miles away. The vessels were towed into the Agulhas Current so that any release of oil would be carried away from the shoreline. The *Venpet* was brought to Algoas Bay for repairs on December 24. The Agulhas Current carried the *Venoil* and one tug 250 miles southwest of the coast. Two tugs were required to tow the *Venoil* into Algoas Bay, where it arrived on January 1, 1978. Lightering operations began on January 4 and were completed on January 7.

Dispersant spraying operations began almost immediately from five Kusweg anti-pollution vessels directed by aircraft. However, by December 18, the oil had emulsified to an extent where the dispersants were not effective. The oil became so thick that it significantly slowed the vessels traversing it. Dispersant operations were scaled down at this point, and only slicks of fresh oil were sprayed. When the second slick was found dispersant operations began there. However, as this slick was also composed of thick, emulsified oil, operations were suspended shortly after beginning. *Approximately 158,500 gallons of dispersant were sprayed on the various slicks.*

Oil impacts to the rocky shore areas were left to degrade under the influence of the weather, except for *one recreational rocky shore beach that was treated by manual removal and sandblasting of rocks followed by dispersant application.* Cleanup on other rocky shores consisted of manual removal of mousse trapped among the rocks. Oiled recreational sand beaches were treated by manual removal of oiled sand and debris. Removal of sand was minimized, and no dispersants were used on the sand beaches. Straw was spread on some sand beaches to absorb the oil. Oiled straw, debris and sand were disposed of in landfills, and in some cases, was buried above the high tide watermark on the beaches where they were collected.

Oil stranded on the river banks, mudflats, sandflats, and the reef near the Brak River areas was removed manually. Sunken oil in the Brak River areas was up to 18 inches thick. *Diaphragm pumps were successfully used to suction the oil from the river and lagoon bottoms.* Drag lines were also used, but removed too much uncontaminated sand when pulled by barges. Small-scale drag line operations were attempted using people to pull the line, but

this proved too exhausting for the workers. A cofferdam was constructed across the mouth of the Little Brak River. One-way pipes in the cofferdam and the use of pumps lowered the level of the lagoon by 4 feet, facilitating suction operations. Straw bale barriers were placed across some areas in the Little Brak River estuary to prevent their oiling.

Other Special Interest Issues:

The greatest wildlife damage was seen in the sand and mudflat areas of the Brak rivers. Crabs and prawns were severely oiled, and mortalities were high. There were reports of about 100 oiled birds, including Cape Gannets and Jackass Penguins, during the course of the spill. It was assumed that many more were oiled but never recovered. The oil missed most of the breeding colonies. Some seals showed irritation to the eyes and mouth after surfacing in dispersant spraying areas. Most of the oil missed the seal breeding areas.

References:

- Genwest Systems, Inc. communications with ITOPF representatives.

Name of Spill: *Vista Bella*

Date of Spill (mmddyy): 3/6/91

Location of Spill: 12 miles northeast of Nevis Island (British), eastern Caribbean.

Latitude: 17 17 N

Longitude: 062 18 W

Oil Product: No. 6 Fuel Oil

Oil Type: Type 4

Barrels: 13,300

Source of Spill: Tank Barge

Resources at Risk: Shrimp aquaculture sites, fish, crabs, eelgrass beds, diving coastal birds, sea turtle nesting beaches, recreational beaches, coral reefs.

Dispersants: Yes

Bioremediation: No

In-situ Burning: No

Other Special Interest: Adverse weather conditions, logistical or operational problems, interaction with foreign or Native authorities.

Shoreline Types Impacted: Exposed rocky shores, sand/gravel beaches, mangroves.

Keywords: Atlantic Strike Team (AST), FINASOL OSR-7, adverse weather conditions, manual removal, skimmer, fingerprinting.

Incident Summary:

On March 6, 1991, the *Vista Bella* sank in the Atlantic Ocean approximately 12 miles northeast of Nevis Island (British). The barge, carrying **13,300 barrels of No. 6 fuel oil**, sank in approximately 2000 feet of water. The wind speed on the day of the incident was approx. 6-10 knots. The cause of the sinking was not determined. The barge was owned by Offshore Marine Limited and operated under the Trinidad flag.

Dispersant was applied from March 9-15, within a two-nautical mile area of the source. The U.S. Coast Guard (USCG) Atlantic Strike Team (AST) was on-scene from March 14-23. Contractor beach cleanup began on March 27.

Behavior of Oil:

No. 6 fuel oil is a heavy product with an API gravity that ranges from 7 to 14. A slick was observed downcurrent from the source (extending from 17 18 N, 062 21 W to 17 26 N, 062 31 W) by observers on a USCG flight on March 7. This slick, which was estimated to cover an area of 7.5 nautical miles, contained patches of sheen with some areas of brown oil. Personnel from the U.S. National Oceanic and Atmospheric Administration (NOAA) predicted that islands up to 100 miles from the source could be oiled under the prevailing conditions.

Personnel aboard a French Customs overflight on March 9 observed the slick moving to the northwest toward the strait between Saba and St. Maarten. Beach oiling first occurred on the islands of St. Maarten (Netherlands Antilles), St. Barthelemy (French), St. Kitts, and Nevis. Beached oil was

confirmed along 14-16 nautical miles of shoreline on St. Maarten and St. Barthelemy by March 12. March 14 overflight observers estimated the slick to be 12 miles long by 200 feet wide. Coverage of oil within this area was estimated at 80 percent, with some breaking up observed at the leading edge of the slick. Although dispersant operations were discontinued on March 15, observers on a March 17 overflight noted that the *Vista Bella* continued to release oil. The area east of St. Kitts escaped oiling. Beach survey results indicated the presence of minor oiling along the rocky shoreline of Sand Bank Bay, and regularly occurring tarballs (2-5 inches) mixed in with the seagrass and sand between Muddy Point and Dieppe Bay. No cleanup of this second area had occurred as of March 19.

By March 25, tarballs were coming ashore on Culebra Island (Playa Brava) in Puerto Rico, 200 miles from the source. Chemical fingerprinting confirmed that the oil was from the *Vista Bella*. Personnel at Playa Larga (Puerto Rico) reported a one-kilometer band of oiling with 100 percent coverage. Oil was also reported on the seaward bases of reefs in the area. Cayo Barca, a NOAA reserve on San Juan, was oiled by tarmats up to one meter in diameter. Eight nautical miles of shoreline on St. John required cleanup and received final assessment on April 8. Cleanup crews recovered tarballs and oiled seagrass. Skimming operations conducted near the source of the spill from April 16-25, failed to recover any measurable oil.

Countermeasures and Mitigation:

Dispersant was applied under the approval of the Caribbean Regional Response Team (CRRT). The French Navy supplied the water-based dispersant *FINASOL OSR-7*, which is on the EPA product schedule. During March 9-15, personnel aboard French and Dutch Navy vessels applied the dispersant using onboard firefighting systems since dispersant application equipment was unavailable. *The use of FINASOL OSR-7 was discontinued on March 15 due to its ineffectiveness on the No. 6 fuel oil.* *FINASOL OSR-52* was considered as a replacement, but was not applied.

Cleanup personnel deployed *boom* at St. Barthelemy. *Snarebooms* were placed along oiled shoreline and across creek mouths to protect mangroves in the area.

Removal of oily debris on Haulover Bay, Mennebeck Bay, Leinster Point, and Threadneedle Point began on March 27. Early cleanup consisted of oily debris removal and manual reworking of the oiled swash line. Pom-poms placed in the surf below reworked sections of swash line were effective in picking up the loosened oil. Bagged oily debris from the beaches of St. Johns was stored temporarily at a facility in St. Johns and later permanently landfilled in Puerto Rico.

Shoreline cleanup was extensive, along the populated tourist beaches of Puerto Rico. Bilingual shoreline assessment forms were prepared. Prison work crews contributed to the beach cleanup under the incentive of reduced

sentences. On less-used recreational beaches, seagrass wrack was left to act as a natural sorbent for a period of time before being removed.

Skimming operations, scheduled to begin on April 12 were delayed until the late arrival of a third vessel. Skimming began on April 16, but was discontinued on April 25 due to the inability of the skimmers to recover oil. On April 21, seven hundred feet of boom parted in 6-8 foot seas. Additional damages to cleanup equipment due to high seas included 250-350 feet of boom, a Zodiac, and a support vessel's transmission. *High sea conditions, inappropriate equipment, and engine problems all contributed to the unsuccessful booming operation at the source of the spill.*

Other Special Interest Issues:

Commercial response equipment was not available on Antigua, St. Kitts, or Nevis. The nearest commercial response equipment was located in San Juan and Venezuela. Local government agencies and companies aided the cleanup effort on St. Kitts by donating equipment. Volunteers and prisoner labor crews helped with the cleanup effort as well.

Early in the incident it was difficult to reach U.S. Embassy personnel in Antigua. Mechanical problems and the difficulty in reaching agency personnel in the area during the weekend both contributed to the communication problem. Due to the differences in electrical current at the cleanup locations, electrical equipment had to be operated while using a step-down power transformer. It was recommended that local aircraft should be used in the event of future spills due to less expensive operating costs compared to the Coast Guard C-130. Smaller aircraft are also more readily available and provide a better observation platform than the C-130.

References:

- MMS Worldwide Tanker Spill Database
- Oil Spill Intelligence Report, Volume XIV, #12, April 4 , 1991
- U.S. Coast Guard Incident Summary Report
- U.S. Coast Guard On-Scene Coordinator's Report

Name of Spill: *Wafra*
Date of Spill (mmddyy): 02/27/71
Location of Spill: Cape Agulhas, South Africa
Latitude: 35 00 S
Longitude: 020 02 E
Oil Product: Arabian crude oil
Oil Type: Type 2
Barrels: 200,000
Source of Spill: Tank Vessel
Resources at Risk: Beaches.
Dispersants: Yes
Bioremediation: No
In-situ Burning: No
Other Special Interest: Wildlife impacts.
Shoreline Types Impacted: Sand/gravel beaches, exposed rocky shores.
Keywords: Sinking.

Incident Summary:

On the morning of February 27, 1971, the tanker *Wafra* was taken under tow off Cape Agulhas, South Africa after her engine room flooded. Later that day the towline broke, and the *Wafra* drifted onto the Agulhas Reef, five miles from Cape Agulhas. Cargo tanks were ruptured, and Arabian crude oil began to leak from the vessel. On March 8, the vessel was pulled off the reef by the tug *Oceanic*, and towed to a position 200 miles from the coast where it was deliberately sunk on March 12.

Behavior of Oil:

Approximately 200,000 barrels of crude oil spilled into the sea, about half of it at the site of the grounding and the rest as the tanker was towed to the site of its sinking. A 30-mile long by 5-mile wide oil slick formed at the site of the grounding. Approximately 45,000 barrels of oil polluted the coastline between Cape Agulhas and Struisbaai.

Countermeasures and Mitigation:

It was decided that the *Wafra* would be towed offshore and sunk in order to prevent a large release of oil in a location where it could threaten the coastline. The vessel was towed to a point 200 miles from the coast of South Africa. The *Wafra* was blown up with missiles from South African Air Force jets and with depth charges. The vessel sank at 36 57 S, 020 42 E on March 12.

A helicopter applied an oil solvent to the slick immediately after it formed, but failed to prevent its spreading.

Dispersant operations were conducted under the supervision of the Division of Sea Fisheries. Five vessels participated in the application of dispersants, and were guided by observers in aircraft.

Other Special Interest Issues:

Dead oiled birds and fish were found on the shore near Cape Agulhas and Struisbaai.

References:

- Genwest Systems, Inc. communications with ITOPF representatives.
- Hooke, N. Modern Shipping Disasters 1963-1987. Lloyds of London Press. 1987.
- The South African Shipping News and Fishing Industry Review: April, 1971. Vol. XXVI, No. 4.

Name of Spill: Whidbey Island Spill
Date of Spill (mmddyy): 12/21/84
Location of Spill: South end of Whidbey Island, Washington
Latitude: 47 50 N
Longitude: 122 25 W
Oil Product: Bunker fuel oil
Oil Type: Type 4
Barrels: 119
Source of Spill: Unknown
Resources at Risk: Kelp, wintering concentration area, diving coastal birds, waterfowl.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Wildlife impacts, habitat impact due to oil, wildlife rehabilitation.
Shoreline Types Impacted: Marshes
Keywords: Fingerprinting, manual removal.

Incident Summary:

At 1130 on December 21, 1984, the United States Coast Guard was notified by a boater of an oil slick off Edmonds, Washington. The actual spiller, estimated to have released 119 barrels, had not reported the incident. Six suspect vessels had their oil "fingerprinted" by the Coast Guard to identify the responsible party. Funds for the spill cleanup initially came from the USCG revolving oil pollution fund. An overflight of the area was conducted at 1400.

The spill occurred during a time when thousands of migratory birds are overwintering in the area. Between 1,500 and 2,000 of these birds were oiled as a result of the spill. Many birds were treated at the South Whidbey Island Wildlife Clinic. On December 23, personnel at a bird clinic established at Mukilteo's Olympic Junior High school began cleaning and feeding hundreds of oiled birds. The birds were washed with dish washing detergent and tube-fed a *mixture of Kaopectate, honey, high-protein baby cereal, activated charcoal, thirst-quencher, and poison antidote* until the center received a high-protein feed donated by Ralston Purina's Woodinville, Washington plant. *Due to this donation and excellent handling, 60 percent of the 428 cleaned birds were last reported as surviving*, as compared to an average survival rate of 20 percent for oiled birds.

Manual cleanup of beaches was most prevalent where waters were too shallow for cleanup vessels. In many of these narrow channels, the water was not deep enough to float boats carrying boom.

Behavior of Oil:

Bunker fuel oil is a heavy product with an API gravity that ranges from 7 to 14. The oil spread into a 10-mile long by 500-yard wide ribbon by the afternoon of December 21. As predicted, the oil also impacted the kelp beds offshore of Possession Point on the southeast edge of Whidbey Island. The oil came ashore along six miles of beachfront on Bainbridge Island's Point Monroe, Yeomalt Point, and Indian Island. Oil also landed on a mile of beach on the east side of Bainbridge Island, as well as scattered patches on Marrowstone Island to the west of Whidbey Island.

Due to cool winter temperatures, the lighter fractions in the oil did not readily evaporate. High tidal ranges in the Whidbey Island area trapped much of the oil in the supratidal zone where there was little marine life.

Countermeasures and Mitigation:

Manual beach cleanup was conducted by personnel under contract to the USCG. Plastic bags full of collected oil and debris were incinerated at *Thermal Reduction Company, Inc.*, in Bellingham, Washington.

Other Special Interest Issues:

Initial *bird mortality* was extremely high in this incident. Detergent washings leave the birds without the natural oils that usually allow them to float and stay warm. It takes from a few weeks to several months for the birds' feathers to naturally re-oil, depending on the species. Delayed stress mortality from the shock of being handled was a likely cause of death as well. Autopsies on dead birds revealed intestines with stripped-off linings while others showed signs of kidney failure.

Chemical fingerprinting, used to attempt to identify the source of the spill, was performed at the U.S. Coast Guard Combined Oil Identification Laboratory (COIL) in Washington, D.C.

References:

- Long term damage of oil spills not known. Seattle Post-Intelligencer, January 4, 1985, p. C22.
- Oil Spill Intelligence Report, Vol. VIII, No. 1.
- Oil Spill Intelligence Report, Vol. VIII, No. 2.
- Oil spill cleanup costs top \$100,000. Seattle Post-Intelligencer, December 27, 1984, p. B12.
- Oil spill far bigger than first thought. Seattle Post-Intelligencer, December 26, 1984, p. D1.
- Volunteers report success in saving oil-soaked birds. The Seattle Times, December 27, 1984, p. B1.
- Whidbey oil spill caught Coast Guard off guard. The Seattle Times, January 2, 1985, p. A1.

Name of Spill: *Witwater*
Date of Spill (mmddyy): 12/13/68
Location of Spill: Galeta Island, Canal Zone, Panama
Latitude: 09 35 N
Longitude: 080 40 W
Oil Product: Diesel, Bunker C
Oil Type: Type 2, Type 4
Barrels: 14,000
Source of Spill: Tank Vessel
Resources at Risk: Mangroves, sea turtles, oysters, mussels, wading birds, coastal diving birds, crustaceans, fish, molluscs.
Dispersants: No
Bioremediation: No
In-situ Burning: Yes
Other Special Interest: Habitat impact due to oil.
Shoreline Types Impacted: Exposed rocky shores, sand/gravel beaches, mangroves, tidal mudflats, fire.
Keywords:

Incident Summary:

On December 13, 1968, the oil tanker *Witwater* broke up in heavy seas off the Atlantic coast of Panama. The breakup of the vessel, and continued leaking of the wreck spilled 14,000 barrels of Bunker C and diesel oil into the water 5 miles from Galeta Island. The oil eventually impacted Galeta Island.

Behavior of Oil:

Bunker C fuel oil is a heavy product with an API gravity that ranges from 7 to 14. Marine diesel oil has an API gravity of 31.3, and a pour point of 23 degrees C. Strong seasonal winds pushed the slick towards Galeta Island. Sand beaches, rocky coasts and mangroves along the island were oiled. Oil collected in a small bay on the island. An estimated 8,000 barrels of oil remained in the bow section of the wreck and leaked at a rate of 50 barrels per day.

Countermeasures and Mitigation:

The United States Coast Guard (USCG), the Smithsonian Tropical Research Institute in Panama, and the Federal Water Pollution Control Administration (FWPCA) responded to the oiling of Galeta Island. Several thousand barrels were pumped from the waters surrounding the island, and approximately 5,000 barrels were ignited and burned in the bay. By December 17, it was estimated that half of the spilled oil was cleaned up.

Other Special Interest Issues:

Both red and black mangrove trees were severely oiled, and the majority of the red mangrove seedlings were killed. Oil damaged many of the mangrove inhabitants, including fiddler crabs, oysters, mussels, barnacles, sponges, tunicates, bryozoans, crustaceans, fishes, and molluscs. Oiled herons and cormorants were also found in the mangroves. Dead sea turtles were found on mangrove beaches.

References:

•Rutzler, K. and Sterrer, W. Oil Pollution: Damage Observed on Tropical Communities along the Atlantic Seaboard of Panama. *BioScience* Vol. 20, No. 4. February 15, 1970. pp.222-224.

Name of Spill: *World Glory*
Date of Spill (mmddyy): 06/13/68
Location of Spill: 65 miles ENE of Durban, South Africa
Latitude: 29 38 S
Longitude: 032 15 E
Oil Product: Kuwait crude oil
Oil Type: Type 3
Barrels: 334,043
Source of Spill: Tank Vessel
Resources at Risk: Diving coastal birds, Nature Reserve, beaches, marinas.
Dispersants: Yes
Bioremediation: No
In-situ Burning: No
Other Special Interest: Adverse weather conditions, effects to tourism.
Shoreline Types Impacted: None
Keywords: Adverse weather conditions, sinking.

Incident Summary:

At 1500 on June 13, 1968, the *World Glory*, bound for Huelva, Spain, broke up approximately 65 miles ENE of Durban, South Africa. At the time of the incident the weather consisted of southwesterly gale force winds, overcast skies, heavy swells, and poor visibility. Only ten of the 34 crew members survived the accident. The stern section of the vessel sank after about two hours, while the bow section drifted southwest with the Agulhas Current. The bow was presumed to sink at 30 06 S, 031 54 E, approximately 40 miles from the initial breakup. All the ship's cargo, 334,043 barrels of Kuwait crude oil, eventually spilled into the Indian Ocean.

The response was led by the Port Captain of Durban. Since the economy of Natal, South Africa, depended on the upcoming winter tourist season, the primary response goal was to keep the oil from impacting the mainly recreational shoreline. Dispersant operations were organized by personnel from the Department of Fisheries and the Department of Industries. Other parties involved in the response include the Department of Transportation, South African Defense Force, the Durban Corporation, the Oceanographic Research Institute, the Natal Anti-Shark Measures Board, and the Council for Scientific and Industrial Research. Wildlife impacts were minimal. Duration of response was approximately 20 days with an estimated cost of \$420,000.

Behavior of Oil:

Kuwait Export crude oil has an API gravity of 31.4, and a pour point of 0 degrees F. On June 17, a 60-mile by 1-mile slick came within two miles of the coast. Thin films of oil were also spotted immediately behind the breaker zone. At this time, authorities predicted the slick would reach the St. Lucia Game Reserve. By June 21, the oil was observed in varying amounts from the Tugela River in the north to Port Shepstone in the south and out to 100 miles offshore. Approximately 150 miles of mostly recreational beaches were threatened.

On June 23, the slick was observed four miles off Durban Bluff. The two halves of the ship were still leaking oil in their positions 47 and 65 miles from Durban. Although dispersants had effectively broken up the slick off Durban Bluff by June 24, a 10-mile by 6-mile slick off the Umhlali River was still posing a threat to the shoreline. Light films of oil were reported near the bluff separating Brighton Beach and the Durban Whaling Station on June 25. No confirmed reports of oil impacting the shore had been received.

Countermeasures and Mitigation:

Fly ash residue from burnt coal was applied in an attempt to soak up oil and settle it on the bottom.

Aerial *dispersant spraying operations* began on June 16. Aerial surveys were performed before dispersant application to create grid surveys plotting the extent of the spill and inshore reconnaissance surveys to track the inner edge of the slick. These surveys identified the areas that were most severely threatened. Initially, non-toxic dispersants were applied between Tongaat and Scottburgh with three *crop-spraying planes*. Although the aircraft provided speed and flexibility, their usefulness was limited due to the large amount of dispersant that needed to be applied and high winds in the area. The aircraft were most useful in applying dispersants to oil behind the breaker zone where ships could not operate.

Due to the growing threat of shoreline pollution, the South African Navy, the Council for Scientific and Industrial Research, and the Oceanographic Research Institute provided four vessels for dispersant operations. After pumps, spraying equipment, and engines were quickly assembled, these vessels started applying dispersants on June 19. Several additional vessels were chartered as well. The larger vessels were fitted with 500-gallon farm tanks so they would not need to replenish supplies as often. At the height of operations, twelve ships were applying up to 20,000 gallons of non-ionic detergents per day. Dispersant operations were completed by July 2.

Other Special Interest Issues:

Southwesterly gale-force winds, overcast skies, 50-70 foot waves, and poor visibility most likely led to the breakup. Winds during the response were primarily moderate to strong south to southwesterly with intermittent calms. While the winds hampered some of the aircraft dispersing ability, favorable currents helped the vessel dispersing operations.

References:

- 1991 World Almanac
- 8/9/91 & 8/28/91 Letters from Daniel Owen at ITOPF.
- Genwest Systems, Inc. communications with ITOPF representatives.
- Gilmore et al. 1970. Systems Study of Oil Spill Cleanup Procedures. Vol.1: Analysis of Oil Spills and Control Measures.
- Hooke, N. Modern Shipping Disasters 1963-1987. Lloyds of London Press. 1987.
- Stander, G.H. 1968. Oil Pollution off the SA Coast - The "World Glory" Disaster. The South African Shipping News and Fishing Industry Review: November 1968. pp. 47-51.
- Tanker Advisory Center, Inc. 1991 Guide for the Selection of Tankers. T.A.C. Inc. 1991.
- Wilson, et al. 1976. "The Spreading, Retention and Clean-up of Oil Spills." University of Rhode Island, Kingston, RI, 1976.

Name of Spill: *World Prodigy*
Date of Spill (mmddyy): 06/23/89
Location of Spill: Newport, Rhode Island
Latitude: 41 26 N
Longitude: 071 22 W
Oil Product: No. 2 heating oil
Oil Type: Type 2
Barrels: 6,873
Source of Spill: Tank Vessel
Resources at Risk: Diving coastal birds, waterfowl, spawning beaches, abundant mollusc beds, beaches, marinas, boat ramps.
Dispersant: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Closure of commercial fishing areas, closure of recreational fishing areas, closure of public lands, human health and safety concerns, research conducted.
Shoreline Types Impacted: Exposed seawalls, piers, exposed rocky shores, coarse sand beaches, coarse gravel beaches.
Keywords: Centers for Disease Control (CDC), Food and Drug Administration (FDA), skimmer, vacuum truck, volunteers, boom.

Incident Summary:

At 1640 on June 23, 1989, the Greek Tank Ship *World Prodigy* ran hard aground on Brenton Reef near the entrance to Narragansett Bay, approximately four miles south of Newport, Rhode Island. The vessel was loaded with 8.2 million gallons (over 195,000 barrels) of No. 2 home heating oil. The grounding tore a 200-foot gash in the hull of the ship, ruptured 9 of the 23 cargo tanks and released approximately 6,900 barrels of oil into the waters of Rhode Island Sound. Immediately before the accident, the vessel was observed operating out of the shipping channel, closer to the Brenton Reef than it should have been. The accident occurred during daylight hours with partly cloudy skies, calm seas, winds NW at 5-10 knots, and visibility 6-8 miles.

The response began immediately. Seven rescue ships and several USCG vessels with boom arrived at the scene of the grounding within eleven minutes. The USCG Atlantic Strike Team (AST) was activated within thirty minutes. The pre-designated Federal On-Scene Coordinator (OSC) was the Captain of the Port (COTP), Providence, Rhode Island. The OSC assumed federal responsibility for the spill response within two hours, following the determination that the incident was beyond the control of the ship's captain and the owners, Ballard Shipping of Monrovia, Liberia. A \$50,000 ceiling on the pollution fund was established, which was later raised to \$3.4 million. The OSC immediately hired cleanup contractors and requested boom and other cleanup equipment. The COTP Providence established a 500 yard safety zone around the grounded vessel.

The vessel was surrounded with three layers of *containment boom*. The remaining cargo onboard was offloaded into barges beginning June 24. The area within the boom was cleaned with skimmers beginning on June 26. The booms remained in place until the vessel was cleared by the OSC to sail on July 2. The *World Prodigy* arrived at New York Harbor on July 3.

Behavior of Oil:

No. 2 heating oil has a minimum API gravity of 30, and a pour point between -6 and -27 degrees C. Approximately **6,900 barrels of No. 2 heating oil were released** into Rhode Island Sound. No. 2 oil is a light refined petroleum oil that floats on the water surface and **quickly evaporates**. This rapid evaporation was critical to the minimal overall environmental impact. The oil did not emulsify and was recoverable with pumps. Favorable weather, winds, calm seas, warm air and warm water temperatures were all factors in the success of the cleanup efforts. The rate of evaporation of the oil was maximized, while the warm weather provided good working conditions for personnel undertaking cleanup and salvage operations.

The impacted areas of Narragansett Bay were predominantly **high-energy rocky headlands and coarse sand and gravel beaches**. This resulted in little deep penetration of affected shorelines by concentrated oil. Impacted areas such as Mackerel Cove and Hull Cove were flushed during regular tidal cycles and subsequent storms, minimizing the environmental effects of the spill.

Countermeasures and Mitigation:

By 2015 on June 23, roughly 3.5 hours after the incident, the vessel was encircled with two layers of **protective boom**; a third layer was in place within eight hours. The oil contained within the boom was removed using **skimmers and vacuum equipment**. Cleanup inside the boom began at 1600 on June 25 and was completed with on June 27.

A dive survey was conducted at 1745 on June 23 to determine the extent of damage to the vessel. At this time, the *T/S World Prodigy* was settling rapidly and there was a possibility that the vessel could break up and sink. The dive surveys videotaped the damaged hull, which showed longitudinal dents running 150 feet on both sides of the vessel, as well as a hole large enough for a diver to enter. By 1030 on June 24, the offloading operation was underway. The vessel was stabilized and the danger of sinking eliminated.

The heaviest concentration of spilled oil was near the vessel. Sheen was reported to the north as far as East Greenwich Bay. Four sensitive sites on Jamestown Island were given priority for cleanup, as well as Narragansett Beach, located on the western shore of the bay. Mackerel Cove was heavily impacted, with oil up to two inches thick on the water surface. Hull Cove was also severely impacted. Both sites were cleaned using containment and sorbent booms, sorbent pads, and vacuum trucks. Cleanup of both sites was completed by June 27.

At both sites, oil penetrated into the sand and was heavily concentrated at the water table. The NOAA Scientific Support Coordinator (SSC) recommended no cleanup methods beyond the use of sorbents and vacuum trucks to prevent accelerating erosion of the beach. The State of Rhode Island closed the beach at Mackerel Cove until August 31 while the Rhode Island Department of Emergency Management (RI DEM) attempted aeration of the beach sediment. Beavertail Point and Fort Weatherhill were the other priority sites on Jamestown Island. Both were significantly affected, and were cleaned with sorbents and vacuum trucks. Cleanup at both locations was completed by June 28.

Moonstone Beach/Charlestown Breachway in Charlestown, Rhode Island, was the location of a nest of eight *Piping Plovers*, an *endangered species*. *Precautionary booming* with over 3,000 feet of sorbent boom kept the beach from being contaminated, though oil did come within 100 yards of the beach.

Offloading of the remaining cargo began on June 24 at 0220 and was completed by the early afternoon of June 28.

Other Special Interest:

During the spill, the oil could be smelled all along the coastline. There were reports of local residents suffering from nausea and headaches from inhaling vapors. Officials saw the need for a system for public service human health advisories from the *Centers for Disease Control* during future spills.

Shellfish beds were immediately closed in the Narragansett Bay area by the State of Rhode Island. Ninety percent of the state's shellfish beds were reopened by June 29, following organoleptic and gas chromatograph analysis by the *U. S. Food and Drug Administration* laboratories in Davisville, Rhode Island and Winchester, Massachusetts.

Scientific and technical support was augmented by forces already in place in the Narragansett Bay area. The University of Rhode Island's Narragansett Bay campus houses the Graduate School of Oceanography, the EPA's Narragansett Laboratory, and the NOAA National Marine Fisheries Service Laboratory.

Five hundred drums of *Corexit 9527 dispersant* and an air delivery system were assembled and ready by 0220 on June 24. *Dispersants were not used because of the sensitivity of many spawning species* to dispersed oil in the water column. Environmental conditions at the time were ideal for allowing rapid evaporation of oil from the sea surface without the use of chemical dispersants.

Volunteers, National Guardsmen, and inmates from the State Adult Correctional Institute were utilized during the spill response. While the National Guardsmen did play an important role in traffic control and logistical support, the use of untrained workers was problematic. Early in the spill there were reports of volunteers deploying and collecting sorbent

material and moving booms. These actions were performed without USCG supervision, and frequently without any prior training, experience or most importantly, protective clothing. While the willingness and concern of the volunteers was appreciated, the use of untrained and ill-equipped volunteers should not be permitted at future spills.

References:

- Golob's 1978-1989 U.S. Spill Report
- Golob's Oil Spill Bulletin v. II nos. 1,2,7,26; v. III no. 7
- Jaworski, C. 1989. Close Call! The Narragansett Bay Oil Spill. Nor'easter. Fall 1989. pp. 16-21.
- NOAA Response Report
- Oil Spill Intelligence Report. v. 12, nos. 27-29,32,34-36; v. 13 no. 51 1989 Summary
- Tanker Advisory Center, Inc. 1991 Guide for the Selection of Tankers. T.A.C. Inc. 1991.
- USCG On-Scene Coordinator's Report *T/S World Prodigy*

Name of Spill: YUM II/Zapoteca
Date of Spill (mmddyy): 10/10/87
Location of Spill: Campeche, Gulf of Mexico
Latitude: 18 48 N
Longitude: 092 35 W
Oil Product: Light crude oil
Oil Type: Type 2
Barrels: 58,640
Source of Spill: Platform
Resources at Risk: Commercial fisheries, unforested upland, shrimp.
Dispersants: No
Bioremediation: No
In-situ Burning: Yes
Other Special Interest: Closure of commercial fishing areas, interaction with foreign or Native authorities.
Shoreline Types Impacted: Brackish marshes.
Keywords: Boom, fire, skimmers, bulldozers, blowout preventer, blowout.

Incident Summary:

On October 10, 1987, the YUM II, a Mexican exploratory oil well located approximately 20 miles northwest of Ciudad del Carmen in the Bay of Campeche under the Zapoteca rig, experienced a blowout and fire. Apparently, a blowout preventer (BOP) valve malfunction caused the initial blowout. Although the BOP had successfully shut the annulus between the drill pipe and well casing, the blind rams failed to shear through the drill pipe that was still in the well casing. Therefore, oil and gas flowed out of the well, up the drill pipe, and onto the platform where it ignited. The oil discharge increased after the escaping gas and oil forced the drill pipe out of the well. The initial fire was extinguished by October 17. As of October 28, the well was still spewing out a yellow gas/crude mix 60-100 feet in the air. The owners of the well, Petroleos Mexicanos (PEMEX), and the Mexican Navy participated in cleanup operations. The well was finally "killed" on November 30.

Even though the incident site was 600 miles from Texas, the slick could have traveled in a northerly direction to reach United States waters depending on the duration of the spill. Accordingly, the USCG Marine Safety Office (MSO) at Corpus Christi, Texas, was notified of the incident on October 13. Verification and correct information were not received until October 16. Even though USCG assistance was refused, the USCG conducted overflights of the area every other day until the well was capped to track the spill response and the movement of the oil. Reports of cleanup activities from the Mexican authorities were infrequent and largely erroneous. Daily reports from the Mexican Embassy to USCG Headquarters in Washington, D.C. were not available when promised.

Behavior of Oil:

The rate of oil discharged was believed to be approximately 30,000 barrels per day based on other production rates in the area. Much of this oil probably burned off.

On October 16, patches of crude oil extended out from the well site 7 miles, while rainbow sheen continued out to 14 miles. A USCG October 18 overflight observed a rainbow sheen 250 yards wide extending westerly from the spill site for 55 miles. As of October 22, oil had been spotted 115 miles west of the well and 45 miles north of the furthest western advance. No impact had been observed on the Mexican Coast at this time.

On October 24, streaks of orange-brown mousse extended west from the well for 8-10 nautical miles. A second slick of the same description was observed approximately 95 nautical miles west of the well. Orange-red bands of heavy sheen were observed drifting west out to 25 nautical miles on October 26. A dark colored oil slick extending on the surface 3 miles downwind from the rig was observed as of October 28. Oil was observed impacting approximately 20 miles of Mexican shoreline southwest of the rig. The most heavily impacted beaches were Tabasco and Campeche. Much of this coastline area contained small islands used for cattle grazing.

On November 1, the slick extended approximately 90 miles to the west of the well. Strong northeast winds moved the oil slick slightly to the southwest near November 7. Some oil patches were blown 15 kilometers up the San Pedro River. Fishermen on Nuevo Campechito beach reported a slick 10 kilometers long and 13 centimeters deep. No more oil was spilled into the water after the capping on November 6. As a result, no oil was observed beyond 16 miles of the well on a November 8 overflight.

Mexican officials reported *75 miles of impacted shorelines*. The final USCG overflight on December 10 noted light sheen 200 feet wide and scattered patches of oil approximately 9 and 10 miles southwest of the well.

Countermeasures and Mitigation:

Although approximately 300-400 feet of *boom* was deployed at the scene on October 17, the booming was ineffective because cleanup vessels were dragging the boom through the slick to break it up rather than using the boom to contain the oil.

From October 18-24, the Mexican authorities conducted a *controlled burn-off* operation. During this burning, 90 percent of the escaping oil probably burned off while 10 percent entered the water. Three firefighting vessels cooled the rig while the oil was allowed to burn. The fire was re-ignited when the engineers did not need to be near the well head in an attempt to keep water pollution to a minimum.

According to Mexican authorities, most of the oil on the ocean was a gas condensate and was successfully skimmed with two *skimmers*, one manufactured by *Vikoma* and the other by *Frank Mohn*.

PEMEX used *bulldozers* to clean oiled beaches. This method was questionable since much of the affected coastline consisted of brackish marshes.

Other Special Interest Issues:

The USCG extended an offer of assistance to the Mexican Navy in accordance with the existing bilateral agreement, even though the oil was not projected to impact U.S. waters or land. The Mexican Navy chose not to accept this offer. Communications between the USCG and the Mexican Embassy were not forthcoming. Overflights conducted by the USCG were the primary source of correct information of the progress of the spill response.

The Mexican Navy ordered fishing cooperatives in Frontera and Barra de San Pedro to keep approximately 300 fishing boats tied up for 25 days. The cooperatives sued PEMEX for 600 million pesos to compensate for lost income.

References:

- IFP Platform Databank
- U.S. Coast Guard POLREP file.

Name of Spill: Z-102
Date of Spill (mmddyy): 12/09/75
Location of Spill: Ensenada de Boca Vieja, San Juan, Puerto Rico
Latitude: 18 28 N
Longitude: 066 08 W
Oil Product: Bunker C, Diesel Fuel
Oil Type: Type 4, Type 2
Barrels: 7,679
Source of Spill: Tank Barge
Resources at Risk: Recreational beaches, industrial water intakes.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Adverse weather conditions, complex salvage operations, interaction with foreign or Native authorities, logistical or operational problems.
Shoreline Types Impacted: Sand/gravel beaches
Keywords: Gulf Strike Team (GST), U.S. Navy Supervisor of Salvage (NAVSUPSALV), vacuum truck, manual removal, weir sump, lightering.

Incident Summary:

On December 9, 1975, the tank barge Z-102 grounded at the mouth of the Ensenada de Boca Vieja, northwest of the entrance to San Juan Harbor. The unmanned barge was loaded with 10,476 barrels of Bunker C and 2,403 barrels of diesel fuel oil when its tow line broke. Attempts to free the vessel from the surf line failed. Heavy surf pounded the vessel for over a week, eventually damaging all ten of the cargo tanks. An estimated 7,679 barrels of Bunker C and diesel fuel were released during the next 30 days. The barge was eventually lightered and beached.

Oil released from the barge affected the beaches within the Ensenada de Boca Vieja. Beaches at Punta Salinas and Levittown were the most heavily oiled. The release of oil and subsequent cleanup operations occurred over a prolonged period, from December 9 to February 5, 1976. Beach restoration in the form of sand replacement continued until April 2, 1976.

Agencies involved in the response included the U.S. Coast Guard (USCG), Gulf Strike Team (GST), U.S. Navy Supervisor of Salvage (NAVSUPSALV), U.S. Army Corps of Engineers (COE), U.S. Environmental Protection Agency (EPA), Commonwealth Department of Natural Resources (CDNR), Puerto Rico Environmental Quality Board, and a host of commercial companies.

Responsibility for the spill and cleanup was initially accepted by McAllister Towing. On December 15, McAllister announced that it would no longer undertake or fund any further cleanup. The Coast Guard then requested and received funding under the Federal Pollution Control Fund.

Behavior of Oil:

Bunker C fuel oil is a heavy product with an API gravity that ranges from 7 to 14. Marine diesel has an API of 31.3 and a pour point of 23 degrees C. During the initial days of the spill, strong currents resulted from the discharge of the Bayamon River. The oil released from the Z-102 moved to the southwest until encountering the river discharge. The oil was then carried out to sea, beyond the mouth of the bay. Some quantities of the released oil that escaped the bay dispersed into the Atlantic. Slicks of oil were observed along the outer coast from Isla Verde to Dorado Beach. These offshore slicks were of constant concern because of the threat to prime tourist beaches. Favorable weather prevented any significant shoreline impacts outside the bay.

As the spill progressed, the river influence diminished. Without the strong river currents, the released oil remained on a southwest course, re-entered the bay, and oiled the shoreline. Shorelines between the Bayamon river and Punta Salinas were affected the most during minimal river current conditions.

On a December 9 overflight, USCG personnel spotted oil escaping from the barge and spreading six to seven miles to the west in a one-half mile wide streak. On December 12, approximately 300 barrels was observed in the surf line at the mouth of the bay. The barge appeared stable and was emitting a silvery oil sheen. On December 16, a release of 1,500 barrels of product was reported. The rate of release was estimated at 200 barrels per hour. Tarballs and tarmats came ashore along the Condado Beach area. Oil began spreading toward the Levittown area beaches on December 17, while streaks of Bunker C threatened the beaches west of Punta Salinas.

The first salvage efforts were conducted on December 30. Salvage attempts resulted in the release of an additional 200 barrels of product. The oil released from the barge collected along the Levittown Beaches. The refloating of the barge on January 7 resulted in another release of oil estimated at 100 barrels. January 8 overflight observers reported only light streaks of oil escaping from the barge and a barely discernible sheen west of Punta Salinas.

Following the salvage of the barge and the lightering operations, the Z-102 was anchored and grounded. A boom was deployed around the vessel to contain any further leakage and none was observed.

Countermeasures and Mitigation:

The response to the Z-102 grounding involved two elements. The first priority was the cleanup while the second involved the prevention of any additional pollution from the salvage operations. Cleanup of the beaches at Punta Salinas was initiated on December 10. *Manual removal was the main form of cleanup of oiled beaches.* Vacuum trucks and hand held equipment was used to remove oil and debris. *Absorbent materials were not used due to the quantity and high viscosity of the oil.* The warm temperatures in Puerto Rico enabled the use of vacuum trucks throughout the cleanup operation.

Where the beach was narrow, small wier sumps (3-5 feet in diameter), were dug in the ground along the shoreline areas of Punta Salinas. The sumps were used as collection points for the floating oil. Larger sumps, up to 30 feet in diameter, were bulldozed along the wider stretches of beach. A trench was cut between the sumps and the bay. As the oil was pushed along the shoreline by the current, tides and wind, the slicks were trapped in the sumps for collection.

Oil also collected along storm sewer outfalls and jetties. Vacuum trucks and cleanup crews were moved along the shoreline from collection point to collection point to recover the oil. Front loaders aided the removal of oil that was deposited within the sediments along the high water line. *A total of 3,212 barrels of water-contaminated product was recovered during the cleanup operation.*

Nighttime cleanup of the beaches was attempted, but was ineffective. At night, cleanup crews were unable to move along the shore with the oil as it drifted. The work area was limited due to artificial lighting and workers had difficulty identifying oil from water in the dark. Working under the artificial lights also caused hazardous conditions among the submerged rocks and debris. The nighttime recovery rate of oil was less than 25 percent of the daytime rate.

Cleaning of the oiled sand was attempted by dumping the sand into the surf zone. This technique was a failure since the active surf required for the cleaning action also dispersed the oil. Recovery of the dispersed oil proved to be impossible. A repeated attempt to clean beach sands with this technique is not recommended.

Nearly 3,400 cubic yards of beach sediment was removed from the beaches during the cleanup operation. Sand removal from the Levittown beaches was substantial enough to require replacement. Personnel from the USCG, EPA, and the Commonwealth Department of Natural Resources (CDNR) agreed that sand replacement was necessary to prevent further erosion. Permits were secured for the excavation of sand from the Bayamon River sand bar. Local sand was used since replacement sand was not available elsewhere in Puerto Rico at a reasonable cost. Cleanup efforts were concluded with the end of sand replacement operations on April 2, 1976. *A total of 3,249 cubic yards of sand was replaced.*

Other Special Interest Issues:

Adverse weather hampered the salvage operations throughout the first week of the incident. The moderation of sea conditions on December 17, finally permitted the boarding and inspection of the vessel. The proposed salvage plan was to bring the Z-102 into calmer waters inside the bay. The proposal to move the vessel was weighed against the possible loss of cargo caused by refloating the barge. The pollution threat from a salvage attempt was determined to be less than the total cargo loss that would likely result if no salvage operation was attempted. The initial attempt to shift the barge was

made on December 30. The vessel was to be beached near the Palo Seco Power Plant, where the remaining cargo would be pumped to the plant for disposal.

By January 1, 1976, the barge had shifted 600 feet toward shore. This was accomplished by creating a head of air within the compartments of the Z-102 and winching the vessel toward shore with beaching gear. The new position of the vessel inside the surf line and fair weather made lightering the remaining cargo possible. Plans were made to establish a better water seal on the vessel since oil continued to leak at a rate of two barrels per hour.

A U.S. Navy landing craft was used to tow a lightering barge to the scene of the Z-102. After lightering 1,500 barrels of product from the Z-102, the lightering barge was beached at the Palo Seco Power Plant. The lightered product was pumped to the power plant for disposal. By January 6, a total of three lightering operations had removed 4,100 barrels of cargo from the Z-102. The Z-102 was re-floated and moored. The barge was eventually moved to a more permanent location in the lee of Isla de Cabras.

The CDNR provided valuable information concerning beach conditions within Ensenada de Boca Vieja. The CDNR also operated as liaison to other Commonwealth agencies.

References:

- USCG Federal On-Scene Coordinator's Report.

Name of Spill: *Zoe Colocotronis*
Date of Spill (mmddyy): 03/18/73
Location of Spill: Cabo Rojo, Puerto Rico
Latitude: 18 00 N
Longitude: 067 15 W
Oil Product: Venezuelan crude oil
Oil Type: Type 3
Barrels: 37,579
Source of Spill: Tank Vessel
Resources at Risk: Mangroves, eelgrass beds, conchs, shrimp, beaches.
Dispersants: No
Bioremediation: No
In-situ Burning: No
Other Special Interest: Research conducted, logistical or operational problems, wildlife impacts.
Shoreline Types Impacted: Vertical rocky shores, sand beaches, mangroves, exposed rocky shores.
Keywords: Weir/pump skimmer, contingency plan, remote response, boom, sorbents, skimmer, vacuum truck.

Incident Summary:

At 0255 on March 18, 1973, the *Zoe Colocotronis* en route to Guayarilla, Puerto Rico ran aground on a reef 3.5 miles off the La Parguera tourist area on the southwest coast of Puerto Rico. The master ordered water and cargo from the forward tank jettisoned to help get the vessel off the reef, so 37,579 barrels of crude oil were intentionally released. The master later stated that the gyro compass, radar and depth sounder were not working properly. No distress or notification calls were made, and the master initially insisted that no oil had been released. Winds were 18-19 knots, and seas were 1-1.5 feet.

Oil started coming ashore on the beaches of Cabo Rojo, on the Bahia Sucia side, by the evening of the grounding. Efforts to minimize beach impacts began on March 19. These efforts involved booming, digging sumps, and pumping the collected oil into tank trucks. On March 21, a substantial number of sea cucumbers, conchs, prawns, sea urchins, and polychaete annelids washed ashore. Organisms were dying in the *Thalassia* beds off-shore as well.

On March 23, the On-Scene Coordinator (OSC) activated the *USCG Atlantic Strike Team (AST)*. Wind shifts had caused more shoreline oiling, and an increase in pumping capability was needed.

After receiving training from the AST, Underwater Technics personnel manually cleaned beaches until April 26, when it was decided to leave the beaches alone since new sand was accumulating rapidly. An estimated 24,000 barrels impacted the shores of Cabo Rojo. The final site inspection was on September 24.

Behavior of Oil:

A large, thick black oil slick measuring 0.10 mile wide by 4 miles long was observed from a helicopter shortly after the grounding. The slick was drifting westward from the vessel towards Cabo Rojo. That evening, thick black oil had visibly impacted the shoreline of Bahia Sucia. Much of the slick moved past Cabo Rojo to the south and entered Mona Passage, posing no immediate shoreline threat.

On March 19, a 0.5-mile by 2.5-mile slick was located moving west one mile south of Cabo Rojo. The shore of Cabo Rojo (on the Bahia Sucia side) was impacted by three separate pools of black oil 6-8 inches thick. These areas were designated A, B, and C with A being the northern, B the middle, and C the southern area. A portion of the slick moved west around Cabo Rojo broke off and appeared to be heading towards Punta Aquila. This oil moved parallel to the beach, then traveled NE and eventually offshore.

On March 23, plans were made to recover the oil still in the mangroves of areas A and B. However, before these plans could be executed, an unexpected wind shift drove patches of oil out of the mangroves in area B into the bay 50 yards offshore of area C. On March 25, oil moved back into areas A and B driven by NNE winds at four to six knots. Oil was now stranded on three miles of shoreline, much of it inaccessible. A large amount of oiled trash and debris continued to wash up along sections of area C.

Countermeasures and Mitigation:

Boom was deployed to protect the beaches of Punta Aquila. Fifty bags of *absorbent* were also spread on these beaches to prevent the oil from mixing with the sand. The oil actually moved by without touching the beach, although the boom showed some oiling. A special configuration of two sections of boom, floats and crossed metal poles placed 200 feet apart was very effective in containing and preventing the oil from moving north up the coast of area C. Absorbents were not used in area C because the oil there was thick, but pumpable.

A *weir sump* with a shallow entrance channel was dug in area C to collect oil. This design allowed much oil and little water to collect so a skimmer could pump oil directly to a tank truck. Additional sumps were dug on the southern part of area C where roads provided access to the beach. Large holding tanks next to the sumps were constructed to hold the oil until an adequate number of tank trucks were available. With help from the AST, pumping operations became more extensive. By March 24, 604,000 gallons of nearly pure oil had been removed from area C using sumps, skimmers, and vacuum trucks.

Two ACME *skimmers* and several *vacuum trucks* transported the recovered oil to CORCO. Clean Water, Inc. provided three *double diaphragm pumps*.

The concrete walls of the salt works intake channel were scoured of all oil traces using a *portable sandblaster*. Steam cleaning was not used because there was no accessible source of fresh water.

Other Special Interest Issues:

Approximately 2.5 acres of mangrove forest died due to oiling. Repopulation of other affected species in the area appeared to be taking place. As of January 1976, sediment analyses indicated that significant levels of petroleum hydrocarbon residues were still present.

Communications difficulties created many problems for the responders. Difficulty in contacting people on a Sunday afternoon slowed initial response efforts. The nearest telephone was 30 miles from the spill site.

Access roads to the impacted beaches were also a problem. *Fiberglass beach mats* were obtained from the Navy to improve access to the northern section of area C.

CORCO, Mobil (which had the vessel under charter), and the ships' owner all declined to accept *financial responsibility* for the spill cleanup. Finally, on March 21, the vessel's insurance underwriters assumed all cleanup costs.

Neither CORCO nor Mobil had any *pollution control equipment* or cleanup personnel in Puerto Rico, so the USCG made the clean-up arrangements. The *Region II Contingency Plan* was grossly out of date. Some of the listed response team members had retired three years prior to this incident. Also, local contingency plans did not include sources of heavy equipment and tank trucks.

References:

- Nadeau, R.J. and E.T. Bergquist, 1977. Effects of the March 18, 1973 oil spill near Cabo Rojo, Puerto Rico on tropical marine communities, Oil Spill Conference Proceedings, 1977, pp. 535-538.
- Tanker Advisory Center, Inc. 1991 Guide for the Selection of Tankers. T.A.C. Inc. 1991.
- The SocioEconomic Impacts of Oil Spills, Final Report, WAPORA, March 1984.
- USCG On-Scene Coordinator's Report

NOAA COASTAL SERVICES CENTER LIBRARY
3 6668 14102 2907

